

DOE'S BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM BUDGET REQUEST

HEARING BEFORE THE SUBCOMMITTEE ON ENVIRONMENT OF THE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES ONE HUNDRED SECOND CONGRESS

FIRST SESSION

MARCH 21, 1991

[No. 16]

Printed for the use of the
Committee on Science, Space, and Technology



U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1991

43-472 ns

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H701-45

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

GEORGE E. BROWN, Jr., California, *Chairman*

JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
HOWARD WOLPE, Michigan
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY L. BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, Jr., Ohio
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
JERRY F. COSTELLO, Illinois
JOHN TANNER, Tennessee
GLEN BROWDER, Alabama
PETE GEREN, Texas
RAY THORNTON, Arkansas
JIM BACCHUS, Florida
TIM ROEMER, Indiana
BUD CRAMER, Alabama
DICK SWETT, New Hampshire
MICHAEL J. KOPETSKI, Oregon
JOAN KELLY HORN, Missouri

ROBERT S. WALKER, Pennsylvania*
F. JAMES SENSENBRENNER, Jr.,
Wisconsin
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID MORRISON, Washington
RON PACKARD, California
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, Jr., Virginia
LAMAR SMITH, Texas
CONSTANCE A. MORELLA, Maryland
DANA ROHRABACHER, California
STEVEN H. SCHIFF, New Mexico
TOM CAMPBELL, California
JOHN J. RHODES, III, Arizona
JOE BARTON, Texas
DICK ZIMMER, New Jersey
WAYNE T. GILCHREST, Maryland

RADFORD BYERLY, Jr., *Chief of Staff*
MICHAEL RODEMEYER, *Chief Counsel*
CAROLYN C. GREENFELD, *Chief Clerk*
DAVID D. CLEMENT, *Republican Chief of Staff*

SUBCOMMITTEE ON ENVIRONMENT

JAMES H. SCHEUER, New York, *Chairman*

HENRY J. NOWAK, New York
DICK SWETT, New Hampshire
HOWARD WOLPE, Michigan
MICHAEL J. KOPETSKI, Oregon
JOAN KELLY HORN, Missouri
RALPH M. HALL, Texas
TOM McMILLEN, Maryland

DON RITTER, Pennsylvania
SID MORRISON, Washington
CONSTANCE A. MORELLA, Maryland
DICK ZIMMER, New Jersey

EILEEN LEE, *Staff Director*
ANNE POLANSKY, *Professional Staff Member*
JOEL EISEN, *Minority Counsel*

*Ranking Republican Member.

CONTENTS

WITNESSES

	Page
March 21, 1991:	
Dr. James F. Decker, Acting Director, Office of Energy Research, DOE, Washington, DC; accompanied by Dr. David Galas, Associate Director, Office of Health and Environmental Research, and Dr. Aristides Patrinos, Acting Director, Atmospheric and Climate Research Division.....	17
Dr. Richard Reba, Director, Division of Nuclear Medicine, George Washington University Medical Center, Washington, DC, representing the American College of Nuclear Physicians and the Society of Nuclear Medicine.....	74
Dr. Robert W. Corell, Assistant Director for Geosciences, NSF, Washington, DC, representing the Committee on Earth and Environmental Sciences of the Federal Coordinating Council for Science, Engineering, and Technology.....	83
Dr. David E. Reichle, Associate Director for Environmental, Life, and Social Sciences, Oak Ridge National Laboratory, Oak Ridge, TN.....	102
Appendix: Additional material submitted for record.....	134

DOE'S BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM BUDGET REQUEST

THURSDAY, MARCH 21, 1991

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON ENVIRONMENT,
Washington, D.C.

The subcommittee met, pursuant to notice, at 1:07 p.m. in room 2325, Rayburn House Office Building, Hon. James H. Scheuer [chairman of the subcommittee] presiding.

Mr. SCHEUER. Today we're going to be taking testimony on the Biological and Environmental Research Program in the Department of Energy. We'll be discussing the 1992 budget request. This program encompasses a broad variety of research projects ranging from human genetics to nuclear medicine, groundwater contamination, and global environmental change.

The Department's program in biological science dates back to the Atomic Energy Act of 1946, which provided for basic biological research on the peaceful uses of radiation, including the treatment of human disease. Some of the world's foremost scientists conduct their research in the Energy Department's National Laboratories or in universities under Department of Energy sponsorship. Many remarkable scientific discoveries have been made because of the research carried out under the Biological and Environmental Research Program.

For example, scientists were astonished to find highly diverse populations of microorganisms buried deep beneath the earth's surface, thriving in conditions once thought to be too harsh to support life. These microbes are now being investigated for their ability to degrade toxic contaminants in groundwater. Such discoveries are made possible in a program which supports long term basic research.

All right, there is a roll call vote on. I'm going to complete my very brief remarks, and then Congressman Ritter will make his opening statement and Congressman Swett, and then—

Mr. SWETT. I don't have any opening statement.

Mr. SCHEUER. You don't have a statement. All right. Very good.

Now, this sort of basic long term research typically doesn't yield immediate answers to the myriad short term problems that face us, but rather enables curiosity-driven scientists slowly to unfold new concepts that may or may not have immediate application. This is the very heart and soul of the basic research enterprise. The cost of delaying an investment in basic research is missed opportunities in

the areas of human health, the environment, and technological competitiveness.

The budget request for fiscal year 1992 for this program is \$312 million, representing a 5 percent increase over last year's research spending. Any prudent taxpayer, any Member of Congress, or subcommittee chairman must ask him or herself: Is the money being spent wisely, productively, cost effectively? Or, more precisely, what research priorities have been set? Are the appropriate hypotheses being tested, are the research projects subject to scientific peer review, peer review of adequate frequency and quality?

These are some of the questions that Members of the Subcommittee hope will be addressed by our very distinguished witnesses. Yet, if we as members of Congress are ready to pose these important questions to the Energy Department, we must also be ready and willing to ask them of ourselves. I don't believe any of us are interested in establishing a double-standard.

In fiscal year 1991, Congress appropriated a total of about \$80 million in so-called earmarked projects, most of which are construction projects for medical research facilities. To give us some perspective, \$80 million represents no less than 22 percent of last year's total budget for the Biological and Environmental Research Program. DOE was forced to pay for these projects out of ongoing research in the base program, research that often did have the benefit of peer review.

Was there a requirement for peer review before any one of these Congressional projects was funded? Of course there was not. Should there be such a requirement? Well, any thinking person would answer, of course there should be. That's why I'm seriously considering introducing a legislative proposal requiring that all construction projects of any significant cost be subject to peer review before funds are appropriated. Very expensive construction projects would require Congressional authorization under this proposal. I'm interested in hearing from our witnesses their reaction to such a proposal.

Each of the witnesses invited to testify here today has had extensive involvement in peer review of research efforts under the BER Program. We look forward to hearing from DOE's perspective and DOE's analysis of the policies and procedures it employs to ensure quality science through peer review and relevant science through a sound priority-setting process.

Each witness on the second panel represents a different scientific discipline and offers a unique perspective on the BER research activities. One is most familiar with nuclear medicine, another with Earth system science to understand the changes in global environment, and a third witness brings to us valuable experience and knowledge of ecological research at one of DOE's leading environmental National Laboratories.

[The prepared statements of Mr. Scheuer and Mrs. Morella follow:]

**OPENING STATEMENT
THE HONORABLE JAMES H. SCHEUER**

SUBCOMMITTEE ON ENVIRONMENT

**AUTHORIZATION HEARING ON
THE DEPARTMENT OF ENERGY'S
BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM**

March 21, 1991

Today we will consider the president's fiscal year 1992 budget request for the Department of Energy's Biological and Environmental Research program.

This program encompasses a broad variety of research projects ranging from human genetics to nuclear medicine, groundwater contamination, and global environmental change.

The Department's program in biological sciences dates back to the Atomic Energy Act of 1946, which provided for basic biological research on the peaceful uses of radiation, including the treatment of human disease.

Some of the world's foremost scientists conduct their research in the Energy Department's national laboratories or in universities under DOE sponsorship.

Many remarkable scientific discoveries have been made because of the research carried out under the BER program.

For example, scientists were amazed to find highly diverse populations of microorganisms buried deep below the Earth's surface, thriving in conditions once thought too harsh to support life.

These microbes are now being investigated for their ability to degrade toxic contaminants in groundwater.

Such discoveries are made possible in a program which supports long-term basic research.

This sort of research typically does not yield immediate answers to our myriad short-term problems, but rather enables curiosity-driven scientists to slowly unfold new concepts that may or may not have immediate applications.

This is the very heart of the basic research enterprise.

The costs of delaying an investment in basic research is missed opportunities in the areas of human health, the environment, and technological competitiveness.

The budget request for fiscal year 1992 for this program is \$312.6 million, representing a five percent increase over last year's research spending.

Any prudent taxpayer, Member of Congress, or Subcommittee Chairman, must ask him or herself: Is this money being spent wisely?

Or, more precisely, what research priorities have been set, are the appropriate hypotheses being tested, and are the research projects subject to scientific peer review of adequate frequency and caliber?

These are some of the questions the Members of the Subcommittee hope to hear addressed by our distinguished witnesses.

Each of the witnesses invited to testify here today have had extensive involvement in peer review of research efforts under the BER program.

We look forward to hearing from DOE its perspective and self-analysis of the policies and procedures it employs to ensure quality science through peer review, and relevant science through a sound priority-setting process.

Each witness on the second panel represents a different scientific discipline and offers a unique perspective of BER research activities.

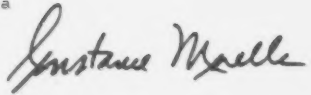
One is most familiar with nuclear medicine, another with Earth system science to understand changes in the global environment, and a third witness brings to us valuable experience and knowledge of ecological research at one of DOE's leading environmental national laboratories.

I welcome you all here today, and yield to my distinguished colleague, the Gentleman from Pennsylvania, for his opening statement.

NOTE: Recognize other members; remind witnesses that in order to permit questions by the members, they should limit their presentation to five minutes and their full written statement will be entered into the record.

Opening Statement, The Honorable Constance A. Morella
Hearing, Subcommittee on Environment

March 21, 1991, 1:00 p.m.



Mr. Chairman, I am pleased to be here today to discuss the progress of the Department of Energy's Biological and Environmental Research Program.

The Committee on Science, Space, and Technology has traditionally had a close relationship with the Department of Energy. We have worked together on critical issues ranging from climate change to the Human Genome Project. It is fitting, then, that we join today to assess the current status of the BER program and to examine ways in which Congress can assist in the DOE's efforts.

Several issues are especially worthy of our attention this afternoon. Foremost among these is the need to examine the effectiveness of the peer review programs instituted by the DOE for its research projects. Are these peer review programs facilitating the establishment of the agency's research priorities? Are the recommendations made by the peer reviews being carefully considered by the Department of Energy? These are the questions that need to be addressed, both in today's hearings and in the forthcoming months.

I am grateful to the distinguished individuals testifying today on behalf of the Department of Energy and its related offices. Your presence here is of considerable assistance to the Subcommittee as we tackle biological and environmental research issues in the 102nd

Congress. I welcome you to today's hearing and I look forward to hearing your testimony.

Mr. SCHEUER. I welcome all of you here today, and at this point I'd like to yield to my distinguished colleague from Pennsylvania for his opening statement.

Mr. RITTER. I thank the Chairman for yielding. I'd like to associate myself with his remarks, and it sounds to me like the bill he is talking about makes a lot of sense, and I would certainly like to join with him in that approach.

The Chairman referred to that he was delighted that I was going to get seated as opposed to just hanging out, and that refers to an article in the Washington Post this morning that had me kind of coming in here rapidly and not really getting down to work, and it had the subcommittee as the "Environment Subcommittee of the Energy and Commerce Committee," which I thought was interesting. But what we tried to tell the reporter was that earlier in the day we had spent—we were doing a lot of different things—but earlier in the day—which is an occupational hazard in Washington—earlier in the day—

Mr. SCHEUER. You and I have 10 minutes to vote.

Mr. RITTER. Okay.

Earlier in the day, we spent three hours on the environmental issue of LUST—the leaking underground storage tanks.

[Laughter.]

Mr. RITTER. But that did not get into the article.

Mr. Chairman, the program which we examine today may have a far-reaching impact on our nation's future. The DOE's Biological and Environmental Program spans across a wide range of research activities. Its main goals are to improve our understanding of long term health and environmental consequences of energy use and development and to address major problems in medicine and biology.

What is the structure of life at its most basic level? The Human Genome Program could offer a dazzling answer to that question. What is the interaction between energy use and global climate change? The DOE's Carbon Dioxide Research Program can help advance the scientific understanding of the complexities involved in modeling global climate change. There are other promising areas of study: advances in environmental science, for example, may someday lead to breakthroughs in technologies for restoration, to be used at DOE cleanup sites.

The BER Program should focus on projects which show the greatest promise for advancement of scientific understanding. Yet nearly one fourth of BER's funds for fiscal year 1991 went to projects which received little, if any, outside scientific peer review. In looking at the list of projects, I focus on one at West Virginia University in Alzheimer's Disease, which I think is a very worthy cause, but one wonders where Alzheimer's Disease fits into the goals of this program. There was also, at South Carolina, a Cardiac Research Institute. Where does that fit in? I'm not sure. I want to again associate myself with the remarks of the Chairman here.

The Committee has a longstanding tradition of promoting rigorous scientific review of research projects. I hope our witnesses will state how they believe the process of scientific peer review of BER projects could be improved in order to set budget priorities which reflect the most pressing research needs.

I commend you, Mr. Chairman, for holding this important hearing, and I welcome our witnesses here today and look forward to their input—after we vote. Thank you.

[The prepared statement of Mr. Ritter follows:]

OPENING STATEMENT
HON. DON RITTER (R-PA)
DEPARTMENT OF ENERGY
BIOLOGICAL & ENVIRONMENTAL RESEARCH PROGRAM
MARCH 21, 1991

THANK YOU, MR. CHAIRMAN. AT THE OUTSET, I'D LIKE TO ASSOCIATE MYSELF WITH YOUR REMARKS ON PEER REVIEW OF THE BER PROGRAM.

THE PROGRAM WHICH WE EXAMINE TODAY MAY HAVE A FAR-REACHING IMPACT ON OUR NATION'S FUTURE. THE DOE'S BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM SPANS ACROSS A WIDE RANGE OF RESEARCH ACTIVITIES. ITS MAIN GOALS ARE TO IMPROVE OUR UNDERSTANDING OF THE LONG-TERM HEALTH AND ENVIRONMENTAL CONSEQUENCES OF ENERGY USE AND DEVELOPMENT, AND TO ADDRESS MAJOR PROBLEMS IN MEDICINE AND BIOLOGY.

WHAT IS THE STRUCTURE OF LIFE AT ITS MOST BASIC LEVEL? THE HUMAN GENOME PROGRAM MAY OFFER A DAZZLING ANSWER TO THAT QUESTION. WHAT IS THE INTERACTION BETWEEN ENERGY USAGE AND GLOBAL CLIMATE CHANGE? THE DOE'S CARBON DIOXIDE

RESEARCH PROGRAM CAN HELP ADVANCE THE SCIENTIFIC UNDERSTANDING OF THE COMPLEXITIES INVOLVED IN MODELING GLOBAL CLIMATE CHANGE. THERE ARE OTHER PROMISING AREAS OF STUDY: ADVANCES IN ENVIRONMENTAL SCIENCES, FOR EXAMPLE, MAY SOMEDAY LEAD TO BREAKTHROUGHS IN TECHNOLOGIES FOR RESTORATION, TO BE USED AT DOE CLEANUP SITES.

THE BER PROGRAM SHOULD FOCUS ON PROJECTS WHICH SHOW THE GREATEST PROMISE FOR ADVANCEMENT OF SCIENTIFIC UNDERSTANDING. YET NEARLY ONE-FOURTH OF BER'S FUNDS FOR FISCAL YEAR 1991 WENT TO PROJECTS WHICH RECEIVED LITTLE, IF ANY OUTSIDE SCIENTIFIC PEER REVIEW.

THIS COMMITTEE HAS A LONG-STANDING TRADITION OF PROMOTING RIGOROUS SCIENTIFIC REVIEW OF RESEARCH PROJECTS. I HOPE OUR WITNESSES WILL STATE HOW THEY BELIEVE THE PROCESS OF SCIENTIFIC REVIEW OF BER PROJECTS COULD BE IMPROVED, IN ORDER TO SET BUDGET PRIORITIES WHICH REFLECT THE MOST

PRESSING RESEARCH NEEDS.

I COMMEND YOU FOR HOLDING THIS IMPORTANT
HEARING, MR. CHAIRMAN. I WELCOME OUR WITNESSES
HERE TODAY, AND I LOOK FORWARD TO THEIR INPUT.

Mr. SCHEUER. We'll recess for about 12 or 15 minutes.

[Recess.]

Mr. SCHEUER. We're waiting just a few moments for Congressman Ritter.

All right, we'll go ahead, and our colleague will be here directly.

Mr. SCHEUER. Our principal witness is Dr. James Decker, Acting Director of the Office of Energy Research at the Department of Energy.

Here we are. We waited for you, Congressman, and we're just doing the introductions.

Dr. Decker has been the Acting Director of the Office of Energy Research in the Department of Energy since October of 1989, and in his current position, Dr. Decker serves as the science advisor to the Secretary of Energy and manages the Office of Energy Research, one of the principal sponsors of basic research in the Federal Government. He is accompanied by Dr. David Galas, an Associate Director of the Office of Health and Environmental Research, which administers the Biological and Environmental Research Program, and also by Dr. Ari Patrinos, the Acting Director of the Atmospheric and Climate Research Division, and he also leads the Climate Dioxide Research Program at DOE.

Okay, Dr. Decker. Why don't you take five minutes— five or six minutes—and give us your testimony, and your prepared testimony will be printed in full in the record. Okay? Please commence.

STATEMENT OF JAMES F. DECKER, ACTING DIRECTOR, OFFICE OF ENERGY RESEARCH, U.S. DEPARTMENT OF ENERGY, WASHINGTON, D.C.; ACCOMPANIED BY: DAVID GALAS, ASSOCIATE DIRECTOR, OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH, AND ARISTIDES PATRINOS, ACTING DIRECTOR, ATMOSPHERIC AND CLIMATE RESEARCH DIVISION

Dr. DECKER. Thank you, Mr. Chairman.

I'm pleased to be here today to discuss the fiscal year 1992 budget request for the Department's Biological and Environmental Research Program.

The explosive advances of the past decade in the biological sciences have put before the Department some unprecedented challenges and opportunities. Biological and Environmental Research programs are designed to provide the scientific foundations for understanding and anticipating the long term health and environmental consequences of energy use and development. Thus, they are a valuable and integral part of the National Energy Strategy. The results of this research also facilitate the understanding and technical solution of major problems of biology and medicine related to these issues.

This program supports research in environmental cleanup and protection, health effects of radiation and chemical agents, and global change. We are also laying the foundations for future pay-offs of basic biological research at the molecular level, such as the human genome program and structural biology.

To accomplish our missions, we rely heavily on the unique multidisciplinary capabilities and facilities of the National Laboratories.

These facilities are used by both the lab researchers and others in the entire scientific community.

I want to take a few minutes to highlight some of the recent technical accomplishments of the Biological and Environmental Research Program. We are supporting the Heard Island experiment, a novel proposal to measure the average temperature of seawater. This experiment has great promise, because it may help us determine how the ocean temperature is changing over time, a crucial consideration in evaluating global climate change. The experiment measures the velocity of low-frequency sound waves, and the velocity is dependent upon the ocean's temperature. The results are now undergoing analysis to test the feasibility of this idea.

In our medical applications program, we are pursuing the search for new and better radiopharmaceuticals for the early detection and treatment of cancer. Researchers at Los Alamos National Laboratory, in collaboration with the Johns Hopkins Medical Center, the National Cancer Institute, and St. Mary's Hospital in Grand Junction, Colorado, are developing a radio-labeled compound that can detect cancer cells and sputum samples from patients with early stage lung cancer. This technique allows detection at a much earlier stage than an X-ray of the lungs. This advancement also has promise as a treatment method for individuals diagnosed as having lung cancer.

A third accomplishment I would like to cite is a spinoff from the human genome program: a new method for determining chromosomal rearrangement has been developed. Since exposure to radiation or chemicals can cause these rearrangements, this method may become a sensitive biological dosimetry technique.

I'd now like to highlight some key research areas in our budget request. First, structural biology. Structural biology is emerging as an important area of fundamental research. Advances in this area will be the key to future developments in the life sciences and the biotechnology industries. Among Federal agencies, the Department of Energy is in a unique position to help the U.S. become the world leader in structural biology research by enhancing the capabilities of the Department's national user facilities, such as synchrotron radiation, and neutron sources.

Another key area is the Department's human genome program. It emphasizes the development of resources and technologies needed to greatly increase the efficiency of constructing chromosome maps and determining the base sequence of DNA. Completing physical maps of each of the 24 different human chromosomes and developing rapid DNA sequencing technologies will dramatically change biomedical research, the way medicine is practiced, and the development of the biotechnology industry. The Department's program has shown great progress this past year. Mapping of chromosomes 16 and 19 is about 60 percent complete. The mapping of five additional chromosomes has also begun.

The genome program was initiated in part because of a recognized need to develop more sensitive methods of measuring human health risks associated with low-level exposures to toxic agents. Based on the knowledge gained from the human genome program, we have begun refocusing our health effects program to better un-

derstand the underlying molecular mechanisms associated with human health risks of various toxic agents.

Another major issue which the Department is addressing is global climate change. The mission of the Department's global change program is to estimate the future levels and rate of increase in atmospheric CO₂, and other energy-related emissions, and to also understand and predict potential effects of emissions on climate and biota. This information is required to provide the scientific basis to evaluate potential energy policy options aimed at preventing, mitigating, or adapting to increasing greenhouse gas concentrations and to global environmental change.

The Department's program is an integral part of the U.S. Global Change Research Program, which is coordinated by the Committee on Earth and Environmental Sciences of the Office of Science and Technology Policy. The program consists of two parts. The first part consists of the core carbon dioxide research program, which addresses the carbon cycle, climate diagnostics, and effects on vegetation. The second part consists of new and enhanced components, the two most significant of which are the Atmospheric Radiation Measurement Program and the Computer Hardware, Advanced Mathematics, and Model Physics Program.

The atmospheric radiation measurement effort is an experimental as well as modeling program to validate the key parameters and climate models, with particular emphasis on the role of clouds. This part of the program will collect data at five key sites around the world, utilizing both ground-based remote sensing platforms and manned and unmanned airborne platforms. The other new component, the Computer Hardware, Advanced Mathematics, and Model Physics Program, will capitalize on the emerging advances in computer systems and mathematical methods to accelerate climate model development.

The Biological and Environmental Research Program also supports research on the physical, chemical, and microbiological mechanisms that determine the movement and chemical transformation of energy-related pollutants through the atmosphere, the oceans, and the terrestrial biosphere. Studies of microbial organisms in subsurface sediments and groundwater will provide the basic scientific understanding necessary for developing advanced technologies for environmental restoration.

The last key area that I'd like to discuss is the medical applications research program. This program covers a broad spectrum of topics ranging from radiopharmaceutical and instrumentation development to clinical feasibility studies. Increased support is also being requested for research and positron emission tomography techniques, monoclonal antibodies for diagnosis and treatment of cancer, and boron neutron capture therapy to treat certain brain tumors.

Let me take a moment to briefly highlight one of these areas. A monoclonal antibody attached to a radioisotope is being studied for the treatment of lymphomas.

Initial clinical studies have demonstrated that a large fraction of the antibody goes to the tumor cells, and the antibody is rapidly cleared from the blood stream. The prospect of this becoming a useful therapeutic agent is very promising.

Mr. Chairman, that concludes my remarks. I'd be happy to answer any questions that you may have. I know that in your opening remarks you had a number of questions associated with how we set priorities and peer review, and I'd be happy to answer those questions. Thank you.

[The prepared statement of Dr. Decker, and the questions and the answers thereto, follow:]

Statement of James F. Decker

Acting Director

Office of Energy Research

Department of Energy

before the

Subcommittee on Environment

of the

Science, Space, and Technology Committee

U. S. House of Representatives

March 21, 1991

Mr. Chairman and Members of the Subcommittee:

It is a pleasure to be here today to discuss the FY 1992 budget request for the Biological and Environmental Research (BER) program. The continuing mission of the BER program is to support research aimed at identifying, understanding, and anticipating the long-term health and environmental consequences of energy development and use. Another part of the BER mission is to use the unique multidisciplinary capabilities and facilities of the national laboratories to solve major scientific problems in medicine, biology, and the environmental sciences.

The BER mission directly supports the National Energy Strategy goals aimed at strengthening the foundations of future U.S. energy security, economic growth, and environmental progress. The fundamental scientific knowledge that flows from the research supported by this program, and the transfer of that knowledge into practical application in the private sector, are key building blocks for the Nation's future economic competitiveness.

The ongoing revolution in the biological sciences is providing the new knowledge and technologies that will allow us to make major strides toward addressing many of today's challenges, including the need to improve our understanding of human health risks from radiation and chemicals, to develop environmental remediation and protection technologies, and to understand the many processes related to global climate change and environmental disturbance.

Several fundamental BER research programs are aimed at enhancing the biotechnology information base relevant to DOE objectives. These programs include fundamental research in structural and molecular biology, studies of

organisms and biological systems that may be useful in environmental remediation, and development of widely applicable new technologies in the human genome program.

The knowledge that will flow from the human genome program will open new levels of understanding about the effects of radiation and chemicals on the most fundamental level of life--the DNA molecule. Combined with the increased understanding of biological structure and function provided by research in structural biology, the results of these research activities are providing and will continue to provide methods, data, and processes for biotechnology applications. DOE's emphasis, in this joint project with the National Institutes of Health, will be to develop and use advanced technologies to analyze the genome and then to apply them to other areas of interest to DOE and the Nation, including human risk assessment, medical applications, biotechnology, and environmental biology.

The knowledge base established by the DOE environmental research program continues to improve our understanding of the processes that affect the environmental impacts of energy-related activities. The understanding of some key processes in the biosphere, both in the oceans and on land, will be critical to our ability to respond to the several challenges of future effects of energy use. We are working to enhance our understanding of these key biological processes. This increased understanding has enabled DOE to respond effectively to national concerns such as acid rain and more recently to global climate change, which may be caused by increases in atmospheric carbon dioxide and other greenhouse gases. In response to increasing concern about global

change, we are expanding research activities to better understand the factors affecting climate change. I will discuss these activities in more detail later in this statement.

Like the health and environmental research programs, the Department's research in medical applications also continues to produce new information and technologies. The advances in medical applications make possible more effective and safer ways to diagnose and treat a variety of diseases, including cancer, heart disease, brain diseases, and metabolic disorders.

The research results and technologies produced by the BER program continue to be recognized for their contributions in the private sector. In 1990, BER-supported investigators garnered four R&D 100 Awards given by Research and Development magazine to the 100 most significant new technical products of the year, adding to the 32 received in previous years. This year's awards went to a kit for rapidly measuring levels of cadmium, a metal which is toxic at high concentrations in the blood, that was developed at Argonne National Laboratory; a kit developed at Oak Ridge National Laboratory for preparing radiolabeled antibodies that very selectively seek out and concentrate in tumor tissue allowing the tumors to be located in the body by medical imaging techniques without the need for surgery; a new instrument developed at Los Alamos National Laboratory (LANL) that rapidly separates large biological molecules, such as DNA, that will assist in human genome studies; and an improved process for detecting fingerprints for law enforcement applications, also developed at LANL.

FY 1992 BIOLOGICAL AND ENVIRONMENTAL RESEARCH BUDGET REQUEST

The FY 1992 budget request for the BER program is \$312.6 million. Of that amount, \$292.3 million is for Operating Expenses, \$16.8 million is for Capital Equipment, and \$3.5 million is for Construction. (Table 1)

The FY 1992 budget request for Environmental Research is \$36.9 million. This research activity, together with the Carbon Dioxide Research activity, which I will discuss next, provides information needed to address a number of important issues, including questions concerning atmospheric chemistry, global climate processes, the resiliency of terrestrial ecosystems and marine coastal areas to energy activities, and the processes that may couple them. Also included is basic research related to environmental restoration that is particularly relevant to DOE facilities used for energy and weapons-related operations and R&D.

Discharges and disturbances from energy sources can either be localized or distributed regionally or worldwide. The Environmental Research request will provide for continued research aimed at determining how energy-related agents move through and are changed by the atmosphere, oceanic, and terrestrial ecosystems as well as how they affect these ecosystems and, ultimately, humans. Our research is also directed to looking at how negative effects of energy-related activities can be mitigated.

In FY 1992, the Environmental Research coastal margins effort will be refocused to complement the international Joint Global Ocean Flux Study. The

Table 1
Energy Supply R&D
Biological and Environmental Research
Budget Authority
(\$ in millions)

	<u>FY 1990</u>	<u>FY 1991</u>	<u>FY 1992 Request</u>
Operating Expenses			
Environmental Research	\$ 39.9	\$ 36.9	\$ 36.9
Carbon Dioxide Research	49.5	65.5	74.5
Analytical Technology	15.0	13.7	13.3
Health Effects	70.8	65.0	36.6
General Life Sciences	55.1	76.9	90.9
Medical Applications	36.9	115.4	34.0
Program Direction	<u>4.8</u>	<u>5.5</u>	<u>6.1</u>
Subtotal	\$ 272.0	\$ 378.9	\$ 292.3
Capital Equipment	11.3	11.5	16.8
Construction	<u>22.1</u>	<u>3.5</u>	<u>3.5</u>
Total BER	\$ 305.4	\$ 393.9	\$ 312.6

margins, which include coastal areas, estuaries, the continental shelf, and the slope, process nutrients and contaminants that interact with land and open ocean systems. New, evolving methods in molecular biology for detecting and identifying microorganisms and understanding metabolic processes will be applied to the microbial ecology of marine and terrestrial systems. The goal of this research is to improve our understanding of the processes of the carbon cycle and of the disturbance and resilience of ecosystems by energy extraction and use. This research is expected to provide the foundation for further research focused on biological remediation.

The FY 1992 Environmental Research request also provides for continuation of long-term research directed at contamination of subsurface sediments and ground water by mixed wastes from DOE sites. This research will provide an improved understanding of the subsurface environment and is expected to lead to cost-effective management and remediation of contamination from the Department's energy and weapons-related project wastes. During the last year, research was carried out to explore the capabilities of submicron-sized particles for scavenging dissolved organic chemicals, such as polyaromatic hydrocarbons, in ground water. The chemical dynamics of these interactions are being studied and new technologies have been developed to measure the physical properties of these particles under natural conditions. This research will assist DOE in controlling the movement of contaminants in the subsurface. In FY 1992, research related to subsurface contamination will continue to be directed at improved understanding of the physical, chemical, and biological interactions that control the transport of mixtures containing mixed contaminants. Research on characterization of the unusual

microorganisms that previous studies have discovered at depths of up to 5,000 feet and on biological remediation techniques also will be emphasized.

Another critical research area in FY 1992 relates to possible global climate change from increases in atmospheric concentration of greenhouse gases, especially carbon dioxide. The Department's Carbon Dioxide Research program, for which the FY 1992 budget request is \$77.0 million, including capital equipment needs of \$2.5 million, is the principal DOE activity in the U.S. Global Change Research Program coordinated by the Committee on Earth and Environmental Sciences (CEES) of the Office of Science and Technology Policy. Since 1978, the Department's research has addressed the many facets of the climate change issue, from the carbon cycle and the climate diagnostics to the effects on vegetation and the impacts on natural and human resources. DOE research has contributed widely to the science assessment of the Intergovernmental Panel on Climate Change and provides a solid scientific foundation for the U.S. position during the ongoing negotiations on the Framework Convention in Climate Change.

The Secretary of Energy has identified global climate change as an important environmental consideration in the development of the National Energy Strategy. Consequently, in FY 1992, DOE is strengthening the research to rapidly improve the predictive capability for global and regional climate change. The focus of the expanded research is on the quantitative links between the rise of greenhouse gas concentrations and climate change and on critical data for first detection of climate change.

The two most important elements of the DOE research are the Atmospheric Radiation Measurement (ARM) program and the Computer Hardware, Advanced Mathematics and Model Physics (CHAMMP) program. ARM is an experimental and modeling program that will improve how climate models describe the important atmospheric processes including the role of clouds. There is a strong consensus that clouds may be the key to the response of the climate system to increasing greenhouse gases and ARM will provide the needed data to elucidate this response.

CHAMMP is primarily a modeling program that is capitalizing on the emerging advances in computer hardware and computer software to increase the computing speeds of climate models by a factor of 10,000 over current state-of-the-science models. CHAMMP is an integral part of the CEES modeling structure and maintains strong ties with the High Performance Computing and Communications Program. CHAMMP is also addressing the predictability of climate change and seeks to quantify the temporal and spatial constraints of this predictability.

The FY 1992 request for Analytical Technology is \$13.3 million. This request will provide for research directed at developing new and more sensitive instruments to make physical, chemical and biological measurements of energy-related emissions. These instruments will also assist scientists in measuring human exposure and biological response to those emissions. These more precise measurements are crucial to further progress in understanding indoor radon, for example, as well as the damage to DNA and to the environment from energy-related agents.

The Health Effects research activity, with an FY 1992 Operating Expenses request of \$36.6 million, will provide for continued research on the potential health effects of exposure to radiation and hazardous chemicals. This research activity will be undergoing significant consolidation and redirection in FY 1992. This new effort will focus on cellular and molecular research to reduce uncertainties in estimates of health effects from low-level radiation or low-level exposures to energy-related chemicals. A key component of this effort will be to apply new technologies and tools being developed in the genome program to health effects research. The goal is to develop improved molecular tools for application in epidemiologic research and health risk assessment. Responsibility for epidemiologic studies of potentially exposed populations was transferred in FY 1991 from the Office of Energy Research to the newly created Office of Health under the Assistant Secretary for Environment, Safety, and Health. The transfer was made in response to a recommendation made by the Secretarial Panel for the Evaluation of Epidemiologic Activities as part of its review of the Department's research activities in this area. The transfer included responsibility for the Radiation Effects Research Foundation's studies of atomic bomb survivors in Japan. DOE has also signed a memorandum of understanding with the Department of Health and Human Services (HHS), under which HHS has responsibility for the management of long-term analytical epidemiological studies.

Another aspect of health effects research will be the cooperative U.S./USSR joint research program following up on the Chernobyl reactor accident. This provides a unique opportunity to obtain data from biological studies. One of the broader goals of this activity will be to develop and evaluate several

promising new approaches for identifying biological indicators of radiation exposure and damage.

The FY 1992 Health Effects request also provides for continuing the basic scientific research needed to understand and predict the health risk associated with exposure to indoor radon. This research includes determining the availability and transport of radon in the environment and its behavior indoors. It also includes measuring and characterizing human exposure to radon more accurately, better defining health risk estimates, and determining the role of radon exposure in combination with smoking in causing lung cancer. Current estimates of the risk of incurring lung disease from exposure to radon are derived from experience with human exposures in uranium mines. Further research, which will include animal, cellular, and molecular studies, as well as exposure studies in indoor environments, will contribute to a reevaluation of the risk at average indoor levels.

The FY 1992 request for General Life Sciences research is \$90.9 million. This program will continue to emphasize structural biology, the molecular and cellular study of complex biological molecules (like DNA and proteins) and of larger cellular structures to determine how key biological processes operate. This knowledge underlies our understanding of how physical and chemical agents affect living processes. The research can also identify early indicators of biological damage, teach us how cells repair themselves, and lead to new techniques for detecting and analyzing biological damage.

Structural biology brings the tools of modern science together to enable major advances in our understanding and ability to manipulate structure and biological function. This knowledge base will provide the intellectual foundation for a wide spectrum of applications of biotechnology and molecular biology, including the design of enzymes and other proteins with predetermined properties and the design of new pharmaceuticals and bio-materials. These applications have enormous implications for the Department's ability to carry out its energy, environmental, and technology transfer missions cost effectively in the future. As pointed out by several DOE and National Academy of Sciences committees, DOE has the opportunity and responsibility to ensure that its user facilities and computational and experimental resources located at the national laboratories are effectively used to advance knowledge in structural biology. In keeping with this view, and in response to strongly increasing demand for use by academic and industrial research groups, the FY 1992 request will increase support for structural biology research at the National Synchrotron Light Source at Brookhaven National Laboratory and the Stanford Synchrotron Radiation Laboratory.

A major FY 1992 focus in General Life Sciences research will be the DOE human genome effort. This research is aimed at developing new instrumentation and methodologies that will facilitate research on the molecular structure of the human genome, which is the complete set of genetic instructions that make a human being. The FY 1992 request of \$59.0 million, which includes capital equipment needs, expands human genome research aimed at developing improved technologies for determining DNA sequences; constructing physical maps of each human chromosome; developing computational capabilities for storing, analyzing

and manipulating data; facilitating technology transfer, and supporting educational and training activities; and addressing ethical, legal, and social implications related to the program. During the past year, significant progress has been made in many of these areas, including advances in the detailed mapping of human chromosomes 16 and 19, which are now 60 percent completed; development of software for rapid electronic acquisition of chromosome mapping data; and initiation of the mapping effort on an additional five of the 24 different human chromosomes. Also during the last year, DOE and the National Institutes of Health (NIH) have revised and coordinated plans for the national human genome program which DOE and NIH jointly plan and carry out in close collaboration. The DOE portion of the program focuses on developing technical capabilities and tools and on physical mapping, which entails locating specific genes and physical DNA segments along the chromosome. The NIH effort emphasizes genetic mapping, which locates the position of genes relative to each other on a chromosome, and characterizing disease-related genes, using both human and non-human model systems.

The Medical Applications activity, with an FY 1992 budget request of \$34.0 million, carries out a wide range of projects aimed at the beneficial medical application of energy-related technologies. Over the years, the Department's medical research has provided information that has led to the widespread use of nuclear technology in modern clinical and laboratory medicine, opening avenues of diagnosis and treatment that otherwise would not have been available. Research in FY 1992 will continue to focus on non-invasive diagnosis and treatment techniques, development of improved instrumentation, and improved methods for studying brain and heart function and for diagnosing

abnormalities in these organs. For instance, certain diseases of the brain affect the ability of specific sites to attract and take up types of chemicals called receptor binding substances. The local concentration of these substances measures the capacity to transmit nerve impulses between brain cells. By using radioactively labeled forms of these substances, it is possible to conduct non-invasive studies of brain functions, thus enhancing the ability to diagnose Alzheimer's disease and other brain disorders. Other radioactively labeled agents are available that are specifically attracted to cancer cells. The uses of these agents in the diagnosis and treatment of cancer will expand through the development of new labeling agents and improved labeling methods.

The FY 1992 request for Program Direction is \$6.1 million. These funds are required for the salaries, benefits, travel, and other expenses associated with 60 full-time equivalent employees required to administer the BER program.

The FY 1992 request for Capital Equipment is \$16.8 million. This request supports replacement of deteriorated and obsolete equipment at the laboratories as well as acquisition of new, state-of-the-art equipment, particularly for human genome and carbon dioxide research.

The FY 1992 Construction request of \$3.5 million provides for the General Plant Projects that are necessary to keep the general plant of the laboratories (e.g., buildings, roads, and utilities) in good operating condition.

This concludes my testimony. I would be happy to answer questions.

Mr. SCHEUER. Thank you very much. I'll ask a few questions, and then I'll yield to my two colleagues for their questions. Thank you very much for your informative description of the important research you're carrying on.

Today I'm less interested actually in pursuing a discussion of the substance of your work than I am in having a look at DOE's internal process for determining research priorities, and also in ensuring that all of the research being conducted has the benefit of full, quality peer review.

In 1983, DOE established the Health and Environmental Research Advisory Committee—HERAC. Now, you established that as an independent advisory group to review and assess research projects that you wish to fund. Is HERAC the only formally established advisory or peer review group for this program, the Biological and Environmental Research Program?

Dr. DECKER. Mr. Chairman—oh, I'm sorry.

Mr. SCHEUER. And if it's not the only one, then please describe the other groups and the nature of their activity.

Dr. DECKER. Mr. Chairman, HERAC is the primary advisory committee to this program. For every research program in the Office of Energy Research, we established an outside advisory committee in the early 1980s. We felt that that was a much-needed, important mechanism for us to get outside advice, both to help establish the priorities within our research programs and also to help us in peer reviewing ongoing programs.

We do have other sources of information that we use in setting priorities in this program, including National Academy studies, which we fund or fund jointly with other agencies. We also use workshops of outside scientists who come in and help us in different areas.

With regard to peer review, we have a number of different peer review mechanisms, which we use extensively. First of all, there is a formal peer review process that is used by the Office of Energy Research, and, in fact, it is published in the Federal Register. In addition to the reviews that are done by HERAC, I would also point to an independent group within the Office of Energy Research called the Office of Program Analysis that is called in to review parts of programs on some regular basis. They are used not only within the Office of Energy Research, but they are called in to review programs in other parts of the Department. They have in fact conducted a number of reviews on the Biological and Environmental Research Program, and I'd be happy to provide you copies of those reviews.

The Office of Program Analysis has conducted six reviews of BER program areas. The two reports prepared and available for public dissemination are attached.

[The material referred to follows:]



Summary Results of an Assessment
of Research Projects in the

Chemical Toxicology Research Program

February 1990

U.S. Department of Energy
Office of Energy Research
Office of Program Analysis
Washington, DC 20545

The Chemical Toxicology Research Program of the Department of Energy (DOE) sponsors fundamental and applied research to understand the interactions with living systems of chemicals associated with energy activities. It is one of two toxicology research programs of the Health Effects Research Division (HERD) of DOE's Office of Health and Environmental Research (OHER). A companion effort investigates the effects of radiation on biological systems.

At the request of the Acting Associate Director for OHER, the Office of Program Analysis (OPA) undertook an assessment of the quality of projects in the DOE Chemical Toxicology Research Program. The 43 individual chemical toxicology projects were reviewed by 5 panels; 1 each on carcinogenesis, mutagenesis, DNA adducts, and toxicology methods (instruments and laboratory methods), and 1 on metabolism, immunologic, and pulmonary toxicology. Each panel consisted of 5 to 10 scientific, technical, or medical peer reviewers knowledgeable in the major Chemical Toxicology Research Program areas.

The purpose of this assessment was to obtain sufficient information for OHER managers to determine the following.

1. Overall quality of research in the Chemical Toxicology Research Program.
2. Overall quality of research within subprograms of the Chemical Toxicology Research Program.
3. Quality of individual research projects within the Chemical Toxicology Research Program.
4. Priority research targets and opportunities for future sponsorship by the Chemical Toxicology Research Program.

Review panels met in San Francisco, California on June 13-16, 1989.

Using factors, criteria, and rating forms defined in the OPA methodology (see *Procedures for Peer Review Assessments*, DOE/ER-0357), each reviewer gave each project appearing before his or her panel a numerical rating. Factors rated include scientific and technical merit and approach, quality of the project team, and probable impact on understanding the hazards of and potential risks to man and living systems from non-nuclear chemicals related to energy production and usage, including emissions. Based on these factors and applying his or her professional judgment, each reviewer then chose a numerical rating for each project's overall evaluation.

Individual reviewer numerical ratings then were displayed and discussed by the panel, after which the chairperson of that panel chose a final numerical rating for each project. Assisted by the panelists most expert on each project, the panel chairperson then matched numerical ratings with panel comments to complete the final rating for each project.

After rating its assigned projects, each panel was asked to identify and discuss the topics it believed were the most important for future research in the area of chemical toxicology reviewed by the panel.

The following sections summarize panel ratings with respect to the quality of the projects reviewed and briefly discuss the topics identified by the panels as the most important for future emphasis in the research program.

Quality of the Projects Reviewed

Individual project quality was rated on a scale from 0.0 to 10.0, with numerical values corresponding to qualitative descriptors; e.g., outstanding, strong, good, and needing

management attention. Ratings of 5.0 to 10.0 signify project quality ranging from good to outstanding. Conversely, descriptors below 5.0 identify projects with deficiencies or serious shortcomings that warrant further review and management attention from DOE program managers.

Figure 1 summarizes the overall ratings chosen for all projects reviewed by the five panels. Seventy-two percent of the projects reviewed (31 of 43) were judged to be good or better; i.e., had overall project evaluations of 5.0 or higher. Twenty-one projects (49 percent) were judged to be strong; i.e., rated 7.0 or better. Two projects (five percent) were rated outstanding (9.0 or higher). Table 1 shows the overall project ratings within each of five discrete areas of research reviewed.

Twelve projects received overall project evaluations lower than 5.0. The reviewers judged these to be projects with important deficiencies or major shortcomings that need to be addressed by DOE program managers. Most of these projects were found to lack focus or to have inappropriate day-to-day direction. These deficiencies and shortcomings were manifested by poor problem definition, lack of technical direction in key research areas, and failure to use capabilities available at the principal investigator's laboratory or facility.

Some of these projects were said to be of only passable originality, others were judged to be using approaches less than state of the art, and some were noted as not following up on previous promising results. A few projects were described as having fundamental design flaws based on faulty assumptions and a limited few to have project teams that were too small to accomplish the necessary tasks.

It is recommended that Health Effects Research Division staff managers reevaluate the projects with low ratings.

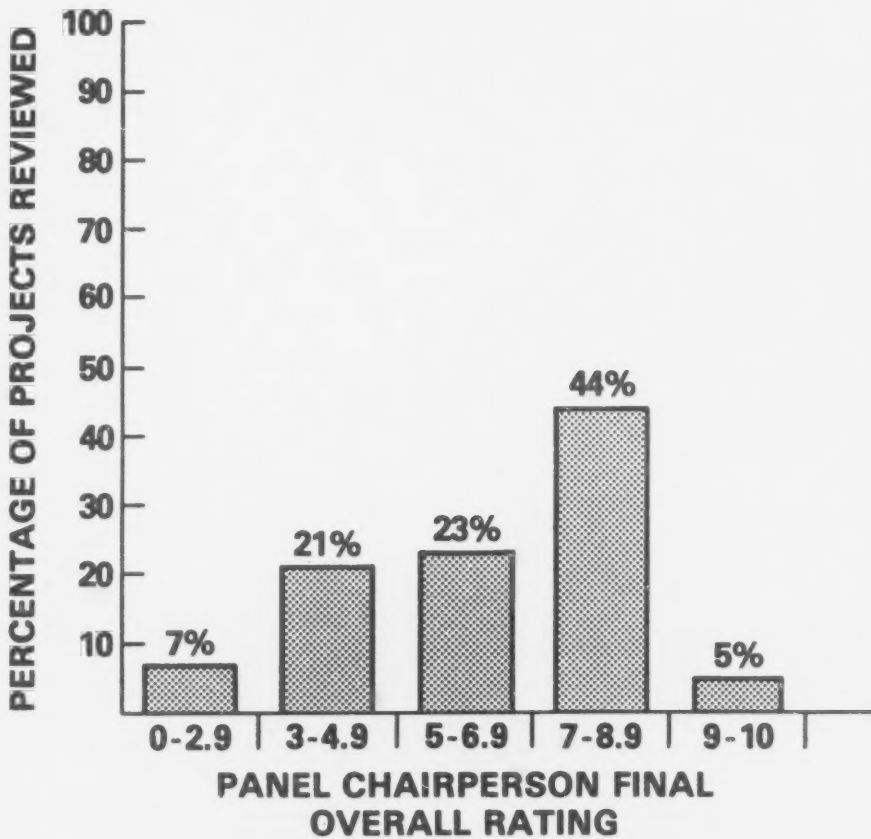
Targets For Future Research

The following is a summary and synthesis of the most important future research targets and activities recommended by the five panels for priority Federal sponsorship in the Chemical Toxicology Research Program.

1. DOE needs to increase its emphasis on mechanisms of carcinogenesis and to continue its support of diverse approaches, including the following.

- a. Models relevant to human carcinogenesis.
- b. Metabolic studies using human or animal cells when there is evidence that the detoxifying mechanism is similar.
- c. A molecular approach to investigate benign and malignant tumors, particularly when the etiology is known; e.g., asbestos, radium. As a corollary, searching cancer for new oncogenes and developing new technology for finding oncogenes.
- d. Determining whether an agent is strictly an initiating agent or a complete carcinogen. Experiments should consider circumstances that result in addition, synergism, or reduction of tumors or metabolites.
- e. Identifying and characterizing a number of genes (suppressor or anti-oncogenes) that appear to negatively regulate the expression of the transformed phenotype.
- f. Human epidemiologic studies of cancer to corroborate *in vitro* or animal studies currently used to test the toxic, mutagenic, and carcinogenic effects of xenobiotics.

FIGURE 1
OVERALL PROJECT RATINGS
ALL PROJECTS



NOTE: An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8.9, while a good project with negligible important shortcomings would receive a score of 5-6.9. A good project with some deficiencies or concerns that should be addressed by OHER/HERD would warrant a rating of 3-4.9, and a project with serious shortcomings which warrants close reevaluation by OHER/HERD would rank 0-2.9.

Table 1
Overall Project Ratings of Program Areas

	Total Projects	Number of Projects Receiving Overall Rating of				
		0-2.9	3-4.9	5-6.9	7-8.9	9-10
<u>Program Areas</u>						
Carcinogenesis	7	1	1	1	3	1
Mutagenesis	10	1	1	4	4	0
DNA Adducts	7	0	3	1	3	0
Toxicology Methods	9	0	1	3	5	0
Metabolism, Immunologic and Pulmonary Toxicology	10	1	3	1	4	1
<u>Totals</u>	43	3	9	10	19	2

Note: An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8.9, while a good project with negligible deficiencies would receive a score of 5-6.9. A project with some deficiencies or concerns that should be addressed by OHER/HERD would warrant a rating of 3-4.9, and a project with serious shortcomings which warrants close reevaluation by OHER/HERD would rank 0-2.9.

- g. Understanding the various arms of the immune system, including both specific (T-cell and B-cell) and non-specific (natural killer (NK) cells and macrophages) mechanisms, and the role of alternatives in the expression of tumor-associated antigens and major histocompatibility antigens in immune recognition and tumor cell destruction.
2. Highest priority should be given to the following areas in mutagenesis and genetic toxicology to sustain and/or improve the program momentum.
 - a. Identifying and examining factors that modify the expression of mutations and/or the activity of mutagens, such as nutrition and dietary factors, combined exposures, deoxyribose nucleic acid (DNA) repair, polymorphism, and germ cell stage sensitivity.
 - b. Monitoring humans for evidence of mutagen exposure; i.e., developing methods to reliably assess human exposure to mutagens (dosimetry) and detect DNA adducts and induced mutation, conducting well constructed epidemiology studies for consideration of health risks in humans, and studying the effect of chemicals and radiation on the human germ line.
 3. Certain DOE-funded programs pertaining to DNA adducts have had a substantial influence. It is important that the DOE continue to fund the following highest priority areas. These are listed in order of decreasing priority.
 - a. New technology and methodology for biomonitoring adducts, which may include fluorescence or immunological approaches.
 - b. Production and characterization of repair mutants in yeast and mammalian cells specifically related to the repair of adducts.
 - c. More powerful and versatile methods for preparing a wide variety of site-specific adducts and determining functional assays for the derived adducts, both biochemically and in mammalian cells.
 - d. Physicochemical interactions between DNA and toxic chemicals associated with energy production.
 - e. Studies to relate DNA adducts to biological effects in specific organs.
 4. To maintain strong research in pulmonary and immunologic toxicology, and in metabolism, there are several programmatic areas deserving of increased emphasis. The priorities are described below.
 - a. Mechanisms that define progression of acute injury to lung fibrosis, emphysema, and cancer are especially important in lung toxicology. It is important that such studies have as their primary focus the disease process itself, with specific toxicants used as tools, rather than a primary focus on chemical compounds. Research in this area should best be designed around the specific biological question(s) being asked, not the chemical compounds to be tested.
 - b. Quantitative extrapolation modeling from animals to man, including toxicokinetic modeling, studies of airway cell metabolism to facilitate studies of regional microdosimetry, and lung metabolism as it relates to specific lung diseases.
 - c. Lung immunology as it relates to factors that aggravate asthma and airway hyperreactivity. The role(s) of energy-re-

lated pollutants as co-factors might be especially important in this area.

d. Studies of pathways and rates of lung clearance of organic compounds and metals and their salts.

e. Further development of newer lung imaging techniques that are non-invasive and of high resolution.

5. The following research topics pertaining to chemical toxicology instrumentation were identified as having the highest priority.

a. Improved analytical methods for detecting, quantifying, and characterizing toxic materials and the products of their interaction with the host. This can include: (1) detection methods with increased sensitivity and methods with increased specificity; (2) methods of characterization for application to very small quantities; and (3) low cost and simple methods for screening large numbers of samples, or for automatic monitoring.

b. Improved methods for studying the effects of the interaction of toxic materials with the host and the biological effects of the toxic materials. This can include: (1) methods for relating exposure to tissue dose; (2) methods for assessing the relationship of the metabolic phenotype to the toxicity to the target organ; and (3) methods for measuring gene sequences related to carcinogenesis.

c. Emphasis on the importance of the respiratory tract as the point of entry of potentially toxic compounds. This can include: (1) on-line methods for characterizing atmospheres generated for studies in inhalation toxicology; (2) technology transfer of aerosol generation equipment; and (3) procedures for selection of appropriate an-

imal models in inhalation toxicology of complex mixtures.

DOE/ER-0360



Summary Results of an Assessment
of Research Projects in the

Nuclear Medicine Research Program

January 1988

U.S. Department of Energy
Office of Energy Research
Office of Program Analysis

Summary Results of an Assessment of Research Projects
in the
Nuclear Medicine Research Program

The Department of Energy's (DOE's) Nuclear Medicine Research program sponsors fundamental and applied research in the medical applications of nuclear and other energy technologies. Begun in the 1940's, when the Atomic Energy Commission first made radioisotopes available to medical practitioners, the Nuclear Medicine Research effort has evolved to encompass isotope and radioisotope research, radiopharmacology research, clinical feasibility research, and instrumentation research. Today, it is a major activity of the Human Health and Assessments Division (HHAD) of DOE's Office of Health and Environmental Research (OHER).

In May 1987, OHER management requested the Office of Program Analysis (OPA) to conduct a peer review of the projects of the DOE Nuclear Medicine Research program. This was done using procedures and a quantitative methodology OPA developed for assessing DOE research programs. Sixty-three individual nuclear medicine projects were reviewed by seven panels; one panel on isotopes and radioisotopes, three on radiopharmacology, two on clinical feasibility, and one on instrumentation. Each panel consisted of five to ten knowledgeable reviewers.

The purpose of the peer review was to obtain sufficient information for OHER managers to determine the following:

1. Overall quality of research in the Nuclear Medicine Research program.
2. Overall quality of research within subprograms of the Nuclear Medicine Research effort.
3. Priority research targets and opportunities for future sponsorship by the Nuclear Medicine program.

Review panels met in Bethesda, Maryland on October 13-15, 1987, and November 2-4, 1987.

Using factors and criteria defined in the OPA methodology, each reviewer gave each project appearing before his or her panel a numerical rating on the quality of science, quality of the project team, and probable impact on nuclear medicine research, development, or clinical practice. Then, applying his or her professional judgment, each reviewer chose an overall numerical rating for each project based on these factors.

Individual reviewer numerical ratings were then displayed and discussed by the panel in executive session, after which the chairman of that panel chose a final numerical rating for each project. Assisted by the panelists most expert on each project, the panel chairman then matched numerical ratings with panel comments to complete the final rating for each project.

After completing ratings of projects assigned to it, each panel was asked to identify and discuss the topics it believed were the most important for future research in the area of nuclear medicine research reviewed by the panel.

The following sections summarize panel ratings with respect to quality of the projects reviewed and briefly discuss the topics identified by the panels as the most important for future emphasis in the research program.

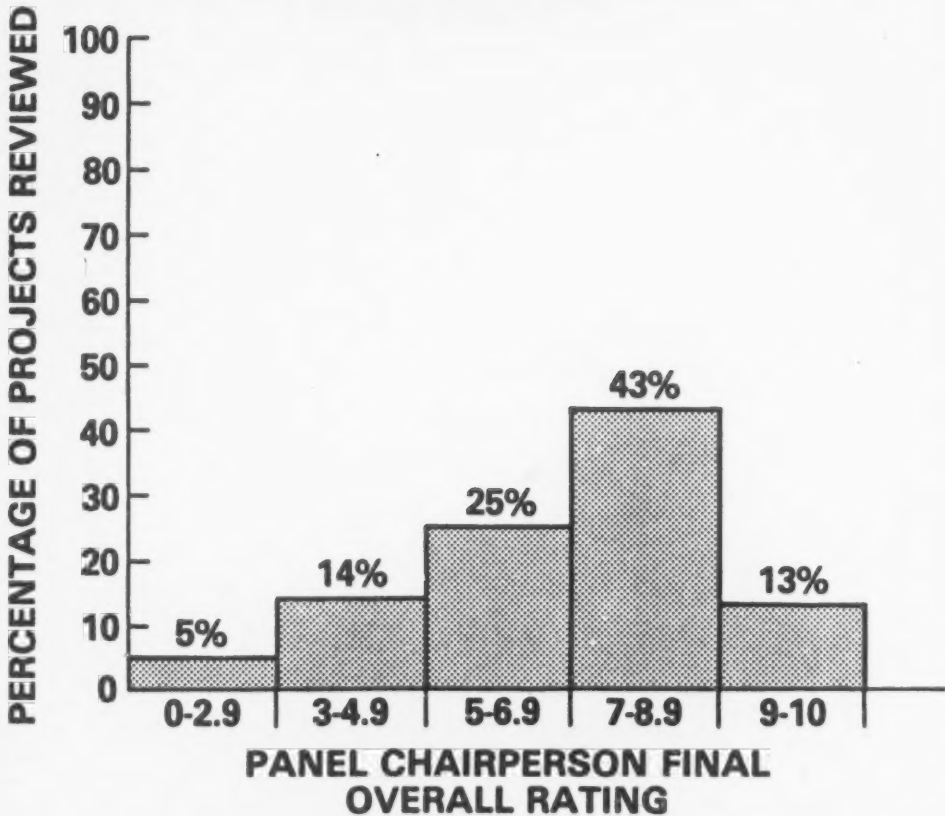
Quality of the Projects Reviewed

Individual project quality was rated on a scale from zero to ten, with numerical values corresponding to qualitative descriptors. Ratings of five to ten suggest project quality ranging from good to outstanding. Conversely, descriptors below five identify projects with deficiencies or serious shortcomings that warrant further review and management attention from DOE program managers.

Figures 1 and 2 summarize the overall ratings chosen for all projects reviewed by the seven panels. Eighty-one percent of the projects reviewed (51 of 63) were judged to be good or better; i.e., had overall project evaluations of five or higher. Twenty-seven projects (43 percent) were judged to be strong; that is, rated as a seven or better. Eight (13 percent) of the projects were rated as outstanding.

Twelve projects received overall project evaluations lower than five. The reviewers judged them to be projects with important deficiencies or major

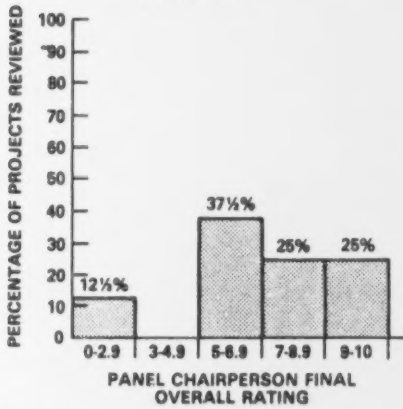
FIGURE 1
OVERALL PROJECT RATINGS
ALL PROJECTS



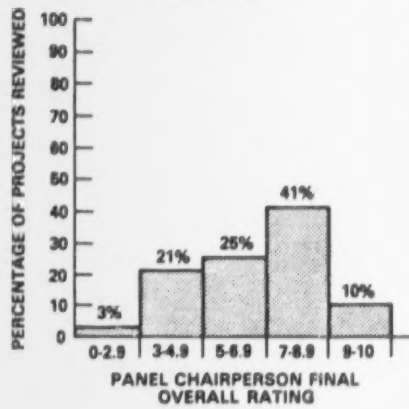
NOTE: An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8, while a good project with negligible important shortcomings would receive a score of 5-6. A good project with some deficiencies or concerns that should be addressed by OHER/HHAD would warrant a rating of 3-4, and a project with serious shortcomings which warrants close reevaluation by OHER/HHAD would rank 0-2.

FIGURE 2
OVERALL PROJECT RATINGS
PROGRAM AREAS

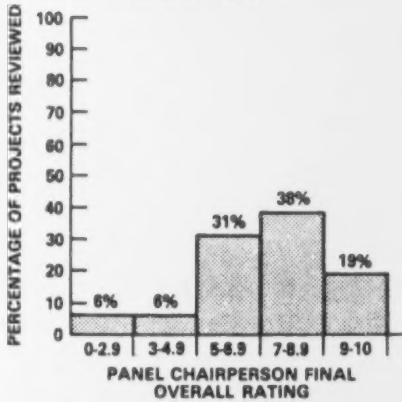
RADIOISOTOPES AND STABLE ISOTOPES
(8 PROJECTS)



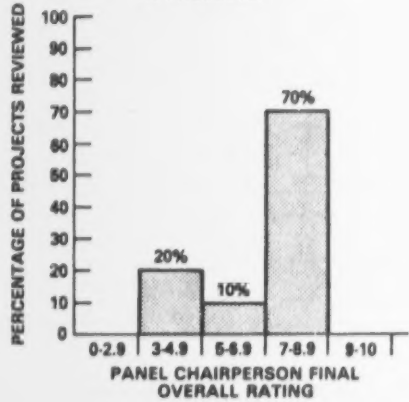
RADIOPHARMACOLOGY
(29 PROJECTS)



CLINICAL FEASIBILITY
(16 PROJECTS)



INSTRUMENTATION
(10 PROJECTS)



NOTE: An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8, while a good project with negligible important shortcomings would receive a score of 5-6. A good project with some deficiencies or concerns that should be addressed by OHER/HHAD would warrant a rating of 3-4, and a project with serious shortcomings which warrants close reevaluation by OHER/HHAD would rank 0-2.

shortcomings that need to be addressed by OHER program managers. Most of these projects were found to lack focus or to have inappropriate day-to-day direction. Some of these were said to be of only passable originality, others were judged to be using approaches less than state of the art, and some were noted as not following up on previous promising results. A few projects were described as having fundamental design flaws based on faulty assumptions.

Targets For Future Research

The following is a summary and synthesis of the most important future research targets and activities recommended by the seven panels for priority Federal sponsorship in the Nuclear Medicine research program.

1. Radioisotopes and Stable Isotopes

The highest three priority research objectives in the area of radioisotopes and stable isotopes are as follows:

- a. Generic research on improved technology for separating and purifying stable and radioactive nuclides.
- b. Expanded research on in vivo applications of nuclear magnetic resonance spectroscopy for diagnosis.
- c. Low level waste disposal technology, including non-lead shielding.

2. Radiopharmacology

The review panels felt that the highest payoffs in the area of radiopharmacology would come in the following areas:

- a. Basic studies in chemistry related to the inorganic chemistry of transition metals, the translations of chemistries from the "carrier added" levels of the research laboratory to the "no carrier added" levels of practical radiopharmacy, novel routes for synthesizing biologically active molecules containing short lived isotopes, ways of linking chelating functionalities to antibodies without adversely affecting the immunoreactivity of the antibodies, and fundamental studies about the biological effects of particulate radiation at the molecular level.
- b. Automation of radiopharmaceutical synthesis (see instrumentation research needs below).
- c. Therapy applications of radionuclides (see clinical feasibility research needs below).
- d. Integration of PET, magnetic resonance imaging (MRI), computed x-ray tomography (CT) and other imaging procedures.
- e. Radiopharmaceuticals for organ systems other than the brain and the central nervous systems and the cardiovascular systems, efforts to measure metabolic processes, work with

receptor binding radiotracers, and studies of presynaptic uptake processes to complete the clinical picture.

- f. Long-term, stable, core support to medically oriented radionuclide production facilities, including research going beyond chemistry to produce the radionuclide and synthesize the ligand; namely, to tests in a reasonable animal model.
- g. New radionuclide generating systems and, for the near term, new compounds based on the molybdenum-99/technetium-99m generators.
- h. Alternate particle accelerator systems for producing radioisotopes.

3. Clinical Feasibility

Research objectives in clinical feasibility are generally defined by progress in instrumentation and chemistry programs. Success in developing a compound or an instrument creates a need for clinical feasibility evaluation, which is the link to further development through alternative funding sources.

Generally, the developmental evolution of new instruments and radiopharmaceuticals within the instrumentation and chemistry programs is insufficiently advanced to warrant their immediate support by the disease-oriented National Institutes of Health funding mechanism or by the commercial sector during further

development. The clinical feasibility component provides the resources necessary to achieve this transition--to transfer the technology--and to capitalize on the innovations derived from the basic science components.

Thus, the panels judged the highest priority of clinical feasibility research is to continue to provide appropriate means for developing promising ideas arising in the instrumentation and chemistry programs into new clinical tools.

With respect to the therapy uses of radionuclides, several specific needs for supporting research were identified as follows:

- a. Radioimmunotherapy studies of the cytotoxic action associated with properly targeting to a specific tumor a radioactive isotope carried by a monoclonal antibody. Such studies would also advance standard chemotherapy and nonradioactive immunotherapy. Planning for the transfer of technology from radioimmunotherapy research is important as confidence in the success of this modality increases.
- b. Putting the Radiopharmaceutical Internal Dose Information Center's data base for internal dose on a National electronic data transfer system similar to the National Library of Medicine's MEDLINE.

- c. Assuring that all clinical protocols and experiments on human subjects supported by DOE supply the formal documentation required to satisfy medical ethics reviews, to formulate legally sufficient consent forms, and to obtain Independent Review Board approval. Moreover, making certain that Food and Drug Administration and Investigative New Drug requirements are complied with by these clinical projects.
 - d. Additional research in isotope radioimmunotherapy to learn if tumor targeting can be done without unacceptable toxicity to normal tissues in the bone marrow, liver, gut, or other vital organs.
 - e. Research on neutron capture therapy to solve the problems of localizing boron throughout the entire tumor, designing and constructing proper neutron delivery systems, and minimizing radiation injury to normal tissue.
 - f. Radiosurgery of other sites of the body; for example, the brain and pituitary gland. These are logical extensions of success realized in developing radiosurgery for arteriovenous malformations.
4. Instrumentation

The following research on instrumentation was identified as having the highest priority:

- a. Single photon emission computed tomography (SPECT) imaging attenuation correction, reconstruction algorithms, and collimator design.
- b. Image analysis and quantification, and two-dimensional and three-dimensional display systems.
- c. In concert with the radiopharmacology area, automated radiochemistry systems for radiopharmaceutical preparation.

Other priority areas include: PET instrumentation imaging systems, magnetoencephalography system development, new photon and charged particle detectors and processors, applying high temperature superconductors to nuclear medicine instrumentation, simulation modeling of clinical applications of nuclear medicine modalities, isotopic separation, developing a whole head magnetoencephalography sensor, and a small accelerator for producing positron emitting nuclides.

Dr. DECKER. In addition, we conduct reviews of ongoing programs regularly. I would say that on the average, programs are reviewed every five years, and some of them more frequently.

Mr. SCHEUER. All right. What formal process is in place for evaluating the recommendations made by HERAC for possible implementation by your Department?

Dr. DECKER. The procedure that we have tried to follow when we get recommendations from any of our advisory committees is that I pass those recommendations to the appropriate Associate Director—in this case, it would be Dr. Galas. He provides comments on the panel's recommendations, indicating to me which ones he feels should be implemented, and if there are some that should not be, why not. Then we usually provide some feedback to the advisory committee on exactly which of the recommendations we are planning to implement.

Mr. SCHEUER. All right. How many of HERAC's recommendations have been acted upon, and how many of them have been rejected?

Dr. DECKER. I would have to supply that for the record. I don't know offhand.

[The material referred to follows:]

COMMITTEE: HOUSE SCIENCE, SPACE
& TECHNOLOGY
SUBCOMMITTEE: ENERGY
DATE: MARCH 21, 1991
WITNESS: DR. JAMES DECKER
PAGE: 20
LINE: 435

INSERT FOR THE RECORD

Disposition of Health and Environmental Research Advisory
Committee Recommendations

To date, the Health and Environmental Research Advisory Committee has made 36 recommendations for consideration by the Department of Energy. A summary of the Department's action on these recommendations follows:

14 of the recommendations have been fully implemented. These recommendations were to increase emphasis and resources in the areas of human genome and global climate change, and to evaluate the scope, balance, and priorities of the medical applications program (particularly boron neutron capture therapy).

18 of the recommendations concerned major program expansions in areas such as structural biology, subsurface science, radiation biology, and complex chemical mixtures. Funding increases were made in the highest priority areas of structural biology and subsurface science to the extent possible within funding limitations. The complex chemical mixtures and radiation biology areas are continuing, but due to budget stringencies, it has not been possible to increase funding levels. Rather, the programs are being reoriented to utilize new approaches such as molecular biology, and genome research to address some of the questions concerning long-term health effects of radiation and chemicals.

Three other recommendations concerned the medical applications program. One was a suggestion to form a DOE/NCI committee to coordinate BNCT research; another recommendation was to build an accelerator facility for production of radionuclides; and further, that if such an accelerator could be made available, additional priority areas of research would be suggested. These three recommendations are still currently under consideration. Formation of an interagency committee appears to be questionable, since NIH has substantially reduced their BNCT research effort. The suggested accelerator facility and associated research activities decisions are contingent upon the total cost of the facility, siting, and cost sharing with the private sector. During FY 1991, ER provided funds to the Society of Nuclear Medicine for a planning and feasibility study of a National Biomedical Tracer Facility. Their report has recently been received by the Department and will be transmitted to Congress upon completion of internal reviews. Construction of such a facility would be the responsibility of the Assistant Secretary for Nuclear Energy, since NE is responsible for the Department's isotope production program.

One other recommendation was a suggestion to bring all Office of Energy Research basic environmental research programs into the Office of Health and Environmental Research. This was partially accepted. The Carbon Dioxide Research program was returned to this office, however, Energy Biosciences remains in Basic Energy Sciences.

Mr. SCHEUER. Do you have any approximate—just a rough estimate? A percentage?

Dr. DECKER. The only thing I could say is in looking over the HERAC reports, of which there are about 10, I would say that the majority of the recommendations have been taken in some form or another. But, of course, the recommendations are not always numbered or very specific, so in some cases it's difficult to assess. But I'd say the majority have been.

One problem that we often face with the recommendations from all of our advisory committees is not having the sufficient resources to implement all of their recommendations.

Mr. SCHEUER. All right. I have a few more questions that I'll ask in a little while, but now I'll recognize my colleague from Pennsylvania, Mr. Ritter.

Mr. RITTER. Thanks, Mr. Chairman. I'm just going to follow up on your questions a little bit.

As you know, we've said it in our opening statements, there is a tradition in this Committee that we try to provide as much as humanly possible the scientific peer review. Not that it's a perfect system, but it seems to be the worst form of reviewing these projects, to paraphrase Winston Churchill, except for all others. He said that about democracy as a form of government.

We understand that nearly one fourth of the funding went to Congressionally-directed projects in the fiscal year 1991. Was there any scientific review in a sense of justifying this, or was this one of these deals where another committee dealing with funds and money sort of rammed it down DOE's collective throat?

Dr. DECKER. Mr. Ritter, there was no peer review of these projects that I'm aware of, certainly none conducted by the Department of Energy. They are, of course, written into the Appropriations Act, and we simply carry out the Congress' instructions.

Mr. RITTER. Let me ask you, would the DOE have undertaken any of these projects if not directed by Members of Congress to do so?

Dr. DECKER. I don't know. I guess I'd have to go back and review the list and see whether there are any that—

Mr. RITTER. For instance, the one on Alzheimer's Disease. Again, it's a very worthy subject.

Dr. DECKER. It's unlikely to fit in with the Department's present program. We have not had any programs, to my knowledge, on Alzheimer's Disease.

Mr. RITTER. Well, if you could just provide that for the record, that would be helpful.

[The information follows:]

COMMITTEE: HOUSE SCIENCE, SPACE
& TECHNOLOGY
SUBCOMMITTEE: ENERGY
DATE: MARCH 21, 1991
WITNESS: DR. JAMES DECKER
PAGE: 22
LINE: 483

INSERT FOR THE RECORD

Projects Added by Congress

None of the activities added to the FY 1991 Biological and Environmental Research (BER) budget by Congress would have received funding from the Department under normal competitive research procedures. A majority of the funds were earmarked specifically for construction of buildings at universities and acquisition of hospital equipment. Both activities are beyond BER's normal scope of operations. The remaining activities added by Congress, creation of new research efforts and expansion of specific existing research, were not considered the highest priority activities when the President's FY 1991 budget was prepared.

Dr. DECKER. I might add that many of the projects that have been written into the budget are buildings and non-research, and so that's another mismatch with this program.

Mr. RITTER. Yes.

Mr. SCHEUER. About 20 percent, I believe, of your budget is devoted to research problems, and I don't want to break into Congressman Ritter's time, but I do intend to ask you about it. I find that objectionable.

Mr. RITTER. The fact that a large percentage of the budget went last year to Congressionally-directed projects, how did that impinge, if at all, on the rest of the peer review process in the program?

Dr. DECKER. Well, it was pretty much separate from the peer review process in the rest of the program. Of course, we had a funding shortfall as a result of directions that were given to us by Congress. There was not enough money added to cover the directions, so we did wind up with a significant shortfall.

Mr. RITTER. Where did some of your shortfalls play out?

Dr. DECKER. They played out in the termination of a number of programs in a variety of areas from health effects, some of our environmental programs, and I believe also in some of our medical applications programs, if I recall correctly.

Mr. RITTER. If you could provide that for the record, too, I think that's kind of healthy information. Often times, we hear that the projects that have been earmarked are great projects and really add to the totality of our ability to do things in science in America. You never hear about what got taken out in order to make way for the earmarked activities.

[The information follows:]

COMMITTEE: HOUSE SCIENCE, SPACE
& TECHNOLOGY
SUBCOMMITTEE: ENERGY
DATE: MARCH 21, 1991
WITNESS: DR. JAMES DECKER
PAGE: 24
LINE: 517

INSERT FOR THE RECORD

Activities Curtailed to Provide Support for Congressionally Initiated Projects

The final distribution of the FY 1991 Appropriation was determined by evaluating Congressional direction contained in Committee reports, which indicated that the human genome and the global climate change activities would proceed at the President's request level. In addition, it was decided that support for other high priority areas such as structural biology, molecular and cellular biology, and terrestrial transport should not be diminished. As a consequence, the areas of dosimetry research, atmospheric sciences and ecosystem functioning and response were reduced approximately 15% below the FY 1990 level of support, while other areas such as health effects research and marine transport experienced a 3-5% reduction below the FY 1990 support level.

Mr. RITTER. Are there any of the BER Program research activities that are more than others subject to extensive and useful scientific review? Global climate change comes to my mind, in that it is often such a controversial issue. Does that gain significant peer review? Is it all the same, or are there some areas that are more subject to sophisticated peer review than others?

Dr. DECKER. Well, I would not want to tell you that our peer review is uniform across all of our programs. I think that areas particularly that are expanding, ones like global change, have in fact received more peer review in the last year or two than perhaps some other areas. I think that's natural.

Mr. RITTER. Mr. Chairman, I think at this stage, with us having to vote, I'm going to yield back to you.

Mr. SCHEUER. All right.

I'm going to recognize Dick Swett from New Hampshire for some brief questions. We haven't had the second bells yet, so why don't you take from now to the second bells plus another two or three minutes, and then we'll all go and vote.

Mr. SWETT. We'll sprint together.

[Laughter.]

Mr. SWETT. I appreciate the opportunity to speak with you, Dr. Decker. Your work, as you have put it forth, I think, is a very necessary and vital part of our ongoing development of technology in this country.

I am faced with a frustration that I think my colleagues share, in that so much of the time we are asked to review these programs that concern millions of dollars, and yet have no real sense of how that money is being spent, I mean in an effective and constructive manner. I think that is why we are all focusing on peer review as an important line of questioning. I'd like to follow the line of questioning that has been established so far and just further develop one area that has caught my attention.

Essentially, we have HERAC having been established for a peer review position, and there has been mentioned one other group, the Program Analysis review under the Energy Research supervision, that has also been used as some kind of a peer review mechanism. Is Energy Research part of DOE? Where does that derive its funding?

Dr. DECKER. Yes, the Office of Energy Research is an Assistant Secretary level office and therefore reports directly to the Secretary.

Mr. SWETT. I guess what I'm hearing is that most of this peer review comes from—its funding comes from the DOE. Is that correct?

Dr. DECKER. Yes.

Mr. SWETT. And is there not a conflict of interest in having that funding derive from the Department of Energy as you are looking into cases of impact of radiation on individuals exposed and similar circumstances?

Dr. DECKER. I believe that we, first of all, are isolated from the production side of the Department of Energy where workers are being exposed to radiation. So there is, to begin with, an isolation between us and the rest of the Department.

Secondly, the work that we have done over the years has been subject to peer review, it is published in open literature, and it is not the Department of Energy that ultimately sets the standards for radiation protection of workers. It is the National Committee on Radiation Protection. That committee uses not only research results that are derived from the work of the Department of Energy, but also from other researchers essentially around the world. And, of course, they also, I should say, have a very close interaction with the International Committee on Radiation Protection.

So I don't really believe that there has been any conflict of interest in this. I think that we have done a very sound scientific job in determining the health effects of radiation, and I would say that I think at this point in time we probably know much more about the health effects of radiation than probably most chemicals.

Mr. SWETT. I appreciate that. I have several more questions, which I will yield my time at this point so that we may go make this vote.

Mr. SCHEUER. All right. Then we'll suspend now for about 10 or 15 minutes.

[Recess.]

Mr. SCHEUER. All right. Congressman Swett, you were just finishing up some questions.

Mr. SWETT. Thank you.

I have literally one last question which I would appreciate your addressing, and it addresses my concern that as we go through this process, we're continually focusing on large blocks of dollars that go into a program, and yet there's little illumination as to exactly how those dollars were spent, and I would like you to please comment on the nature of the reviews that are conducted by any of the bodies that perform these peer reviews on your work and let me know, in particular, but let the subcommittee know whether those reviews are conducted along financial lines, along lines of research, on a mission-by-mission basis, or if there is a larger goal in mind that maintains the integrity of these reviews so that we are able to see that as funds are removed from the program or added, if the unusual opportunity of adding funds ever occurs, that it is done with some kind of forethought and plan so that that research will continue to benefit by a continuum instead of a stop-and-start effort.

Dr. DECKER. Mr. Swett, our peer reviews and our setting of priorities are carried out at different levels. They are certainly carried out within subprograms in an area like our carbon dioxide research program, for example. They are carried out across a broader—in fact, across the whole program—by the Health and Environmental Research Advisory Committee. In all cases, we are using outside experts, the best experts that we can find, who provide us with reviews and provide us with guidance on priorities for these programs.

I would be pleased to provide you with a list of the types of reviews and the number of reviewers involved and so forth so you get some feel for the extent to which we do use peer review in these programs. It is very extensive.

Mr. SWETT. That would be most helpful to me, because I am having a difficult time grappling with the specifics, and it's an area

that I feel often times is left out, and my interest is in oversight as much as it is in looking at the overall budget and supporting the appropriation.

[The information follows:]

COMMITTEE: HOUSE SCIENCE, SPACE
& TECHNOLOGY
SUBCOMMITTEE: ENERGY
DATE: MARCH 21, 1991
WITNESS: DR. JAMES DECKER
PAGE: 29
LINE: 642

INSERT FOR THE RECORD

Biological and Environmental Research
Peer Review Process

The Biological and Environmental Research (BER) program establishes and maintains its high level of scientific merit through the peer review process. This is accomplished through a number of peer review procedures. These are outlined below:

Panels

To review research proposals received in response to specific program solicitations, review panels are assembled. All submissions are reviewed by the panel and ranked in order of scientific priority. Technical staff in the Office of Health and Environmental Research (OHER) also review the proposals for programmatic priority. A final ranking is then established and the available funds allocated to the highest ranking proposals.

Letter Reviews

New proposals received during the course of the year from both the national laboratories and from universities that are not submitted in response to a specific solicitation are reviewed individually by mail review. Technical staff within OHER select three or four reviewers in the particular scientific area of interest and request a written review of the proposal. These reviews are analyzed by the technical staff person, summarized and presented before the OHER Research Committee. This Committee is comprised of OHER technical staff, cutting across all of the scientific disciplines of the BER program. Senior staff within OHER evaluate the programmatic priority of each proposal. Funding is allocated on the combined basis of technical merit and priority. The procedure is also employed for review of extramural renewal proposals at three year intervals.

HERAC

The Health and Environmental Advisory Committee (HERAC) was created in 1983 to provide broad oversight and review of the BER program. It reports to the Director, Office of Energy Research, and responds to specific charges developed by that Office. HERAC usually addresses issues such as scope, balance, and direction within selected program areas. HERAC has conducted eleven program reviews of the BER program since 1984.

Office of Program Analysis

The Office of Program Analysis (PA), within the Office of Energy Research, is charged with conducting scientific peer reviews of selected research areas in the Department. Acting independently of the program office which funds the research, PA convenes panels of scientific experts to hear technical presentations from each research investigator in the selected research area. The technical merit of each project is determined quantitatively and a meritorious ranking is obtained. Six program areas within BER have been reviewed by PA over the past three years.

Site Visits

OHER, which manages the BER program, periodically organizes and conducts site visits to review specific laboratory and university programs. Technical staff within OHER select reviewers and conduct a 2-4 day visit to the research institution. Individual evaluations are prepared by each of the reviewers and returned to OHER. Approximately 30 site visits have occurred within the BER program over the past three years.

Other Review Processes

Other processes have also been employed to obtain peer review of specific components of the BER program. The National Academy of Sciences has conducted evaluations of selected program areas at the request of the Department. Similarly, the JASON group has provided an assessment of the scientific merit

of new proposed program activities. (JASON is a group of approximately fifty-five individuals dedicated to sophisticated scientific and technical research and analysis in support of the national security community.) In addition, interagency committees such as the Committee on Earth and Environmental Sciences have conducted peer reviews of program elements.

Mr. SWETT. I yield the balance of my time back to you, Mr. Chair, and thank you very much for your testimony in this matter.

Mr. SCHEUER. Thank you very much, Congressman.
Congresswoman Morella?

Mrs. MORELLA. Thank you. I appreciate that. Mr. Chairman, may I ask unanimous consent that my opening statement be included in the record?

Mr. SCHEUER. Yes, indeed. It will be right after the statements that we made at the beginning of the hearing.

Mrs. MORELLA. That would be splendid placement. Thank you. Where I posed some of the problems that have been coming out in the discussion and indicated how pleased I was to have such prominent witnesses in an important meeting.

I was at a signing earlier today, and it had to do with DOE and Los Alamos Laboratories and a wonderful private company that happens to be in Maryland's 8th Congressional District called Life Technologies, Incorporated. It was an excellent example of CRADA, the Cooperative Research and Development Act, in practice—the fact that you have the public laboratories working with the private segment, with DOE involved in it. I wondered if you wanted to make any comments for the record about that. I just found it to be an exciting role model of what we need to do, and it came under the—it was set up under the Technology and Competitiveness Act, which came from this committee on the House side. I'll give you a chance to say something about it. I'm excited about it.

Dr. DECKER. Thank you. We're excited about it, too. We believe that the CRADAs are in fact an extremely important and useful technology transfer mechanism. We are seeing a lot of very good proposals coming in from our laboratories to join with companies for more of these CRADAs. They're coming in all the time, and many of them are really excellent.

Dr. Galas, you might want to make some comments about the particular one today, but just one more comment. Technology transfer in general is a very high priority with Secretary Watkins and Deputy Secretary Moore, and it is featured very prominently in the National Energy Strategy. We believe that it is an extremely important mission of the Department.

Mrs. MORELLA. Before he responds, Deputy Secretary Moore made a statement to Mr. Thompson, President and CEO of Life Technologies, Incorporated, and he said, "You are also to be commended for your patience," and I wonder if this is saying something about the system we have where the private companies need to have an inordinate amount of patience, or did I take it out of context?

Dr. DECKER. I think that—I'm not quite sure what that remark referred to, but in the past, it certainly has been difficult for private companies to enter into cooperative research agreements. There have been lengthy approval processes required on the Government side. Things don't go smoothly and quickly on the industry side, either, we've found out. But in establishing our process for the CRADAs, we have very much tried to streamline the approval process so that the approvals can in fact be provided at the lowest level—essentially, at the laboratory and our operations office level,

rather than even coming back to headquarters. But we are trying to fix that problem.

Dr. GALAS. With respect to your comment about patience, I think that Deputy Secretary Moore's comment is particularly appropriate, in that this first one in fact had worked out many of the kinks and led to the sort of streamlining that Dr. Decker just referred to, and the great hope is that in the future, patience will not be nearly as necessary.

Perhaps a quick comment on that CRADA, which we are particularly proud of, because it comes from the human genome program of the Department of Energy. It is a project which I think is in the tradition of the kind of capitalizing on the technological opportunities that present themselves naturally in a place like the Los Alamos National Laboratory. There we have multiple scientific endeavors going on in the same place, and the idea of using physical, chemical, and biological technologies coming to bear on a particularly sticky technical problem that stands in the way of the human genome program, namely the rapid sequencing of large tracks of DNA, I think is really notable, and so I certainly concur with your pleasure, and we hope there will be many more under the same program.

Mrs. MORELLA. I encourage you to continue to foster them, too, and this Committee stands ready to assist in any way that you feel appropriate, and I do have a bill that I've submitted with regard to technology transfer of computer software that I think will be of great assistance.

I know we're going to have to vote again, but I wondered what can this Committee—following up on some of the other peer review questions that have been asked, what can this Subcommittee, as the authorizing Subcommittee for the BER Program—what can we do in the DOE authorization process to ensure that only projects which have undergone rigorous review are those which get appropriated funds? If you'd like to comment on that.

Dr. DECKER. I'm not sure what I can advise you to do. You probably have a much better idea of what you can do in your committee to help us in that regard. But, obviously, we are concerned about the trend in recent years which really has cut into, in a very major way, into some of our ongoing research programs.

Mrs. MORELLA. So you think it's up to us, then, to look to what we can do to prevent some of the extreme number of the kind of designations that take you off course a little bit?

Dr. DECKER. I think if there were some additional controls, it would be helpful. As I say, I don't know what to advise you at this point.

Mrs. MORELLA. Did you want to comment on that?

Dr. GALAS. No, I would just concur with what Dr. Decker said. There has been a significant impact. There are different types, and that is something to take into account. There are the construction projects that Dr. Decker mentioned, and there are other things which are sort of in a gray area between peer review programs and construction projects, that is, designating a specific area to fund research in, which is—

Mrs. MORELLA. It takes away from the peer review in a way, doesn't it?

Dr. GALAS. Which takes away from the peer review in the sense of setting priorities within the program, but not necessarily on a specific project-by-project basis.

Mrs. MORELLA. Maybe it's something we must grapple with a little bit.

Dr. GALAS. I guess I'm just pointing out that there is some complexity in the issue that perhaps has not been brought out.

Mrs. MORELLA. Thank you very much for your comments.

Dr. Patrinos, do you feel slighted that I didn't—

[Laughter.]

Dr. PATRINOS. No, I do not.

Mrs. MORELLA. Thank you.

I yield back the balance of my time.

Mr. SCHEUER. Thank you.

Congressman Ritter?

Mr. RITTER. Thanks, Mr. Chairman.

I want to commend you on the program you're sharing with industry, too, because I think it's awfully, awfully important that we take advantage of this tremendous resource—that is, our National Laboratories.

Dr. Decker, you testified that the focus of the carbon dioxide research program is on quantitative links between greenhouse gas concentration and climate change. That's apparently one of the great uncertainties in this debate and that we need to resolve, and yet it's absolutely critical—the critical element—in any policy that our national government would come up with toward global warming.

Could you comment on the progress of this research, something perhaps about your results, the kinds of peer review you would sustain on this, and the ability to stay out of what I would call “political science” that in some cases surrounds this issue?

Dr. DECKER. Mr. Ritter, I think that it's best that I ask Dr. Patrinos, who runs this particular program, to respond.

Mr. RITTER. That's fine.

Dr. PATRINOS. Thank you, Mr. Ritter, and I am delighted to be given the opportunity to describe to you the—

Mr. RITTER. Finally, you get a chance to speak.

[Laughter.]

Dr. PATRINOS. Indeed. Thank you very much.

I would like to give you some details about the levels of review that we conduct in the carbon dioxide research program, which is in fact the focused program in the Department of Energy within the U.S. Global Change Research Program, which is coordinated by the Committee on Earth and Environmental Sciences of the Federal Coordinating Council for Science, Engineering, and Technology.

Mr. RITTER. Are you the key player on that particular —

Dr. PATRINOS. I am indeed.

Mr. RITTER. And is DOE the key player on the relationship of carbon dioxide—the quantitative measurements of carbon dioxide?

Dr. PATRINOS. There is no one key player in the U.S. Global Change Research Program. I think this program is in fact the paradigm of interagency cooperation and coordination in a problem that transcends individual agencies and is a part of the Administration's program.

To give you the details of the review that you've asked for—

Mr. SCHEUER. Excuse me. We have to leave in three minutes, and I have one question when Congressman Ritter is finished, and then perhaps you could give us the details by mail.

Are you finished now?

Mr. RITTER. Do you want to ask your question?

Mr. SCHEUER. Let me ask my question, and then I'll start over, and Congressman Ritter can take another couple of minutes.

Are there any projects in the program that have not been peer reviewed within the last year or two? And if so, please identify them.

Dr. PATRINOS. There are absolutely no programs that have not been peer reviewed in the last couple of years.

Mr. SCHEUER. Okay. Thank you.

Congressman Ritter?

Mr. RITTER. Gee, that was one of the quickest insertion questions, especially coming from a subcommittee chairman.

[Laughter.]

Mr. RITTER. Thank you, Mr. Chairman.

Dr. Patrinos, please continue.

Dr. PATRINOS. I identify seven levels of review that have been conducted and are being conducted within the carbon dioxide research program.

The first is the so-called mail review that we conduct for proposals that arrive unsolicited to the program and that funds are made available for funding. This is the standard peer review procedure that, for example, the NSF and other agencies conduct.

The second one is the panel reviews that we conduct, which are in response to solicited proposals by announcements that we put, for example, in the Federal Register. These are panels that we put together of experts that sequester themselves for up to a week and decide on the merit of individual proposals.

Number three is something that you've already addressed, and that's the statutory advisory committees that we have like HERAC and BESAC. In fact, the DOE Global Change Research Program has recently been reviewed by a joint subcommittee of the HERAC and also the BESAC, which is actually the Basic Energy Sciences Advisory Committee, another office within the Office of Energy Research.

I also would like to mention the National Academy of Science review of the program which was done as part of the whole U.S. Global Change Research Program. You may be aware of the little orange document that the National Academy issued last year.

I also want to mention specific reviews that we conduct for the two principal programs within the carbon dioxide research program that Dr. Decker referred to: the Atmospheric Radiation Measurement Program and the Computer Hardware, Advanced Mathematics, and Model Physics. These are the two most important programs we presently have within the carbon dioxide research program. For those, we conducted open scientific reviews, meaning we sent the program plans to the scientific community, both nationally and internationally, and solicited comments. We also held public meetings to bring together the experts that reviewed the program

to give their comments orally and listen to the responses of the principal investigators associated with the program.

I also want to highlight a specific role that the group jason serves for those two programs. They are in fact the technical oversight group that reviews the program on a regular basis and assures its technical competence, its balance, and its integration with other aspects of the program.

Finally, last but not least, I would like to mention the regular review that the Committee on Earth and Environmental Science's Working Group on Global Change under the chairmanship of Dr. Robert Corell, who will be on the next panel, conducts on a regular basis every year for all programs that are part of the focused Global Change Research Program, I'd be glad to enumerate some of the criteria that are used: for example, relevance and contribution to the overall program; scientific merit; the readiness; the linkages to both national and international programs; the costs with respect to other programs that have been put forward; the relationship of new programs versus ongoing programs, how that balance works out; and, finally, the agency approval.

So I have enumerated at least seven different types of reviews that the programs within the carbon dioxide research program receive.

Mr. RITTER. Thank you, Dr. Patrinos.

Just for closing, maybe a 30-second verse, could you tell us where the results have gone and what you're finding thus far? I know Dr. Corell would probably be in a position to give perhaps more detail on that, but with the idea that we've got a vote and I've got a 3:00 meeting, I'd like to get a quick and dirty—

Dr. PATRINOS. I can say that we are making significant advances in reducing scientific uncertainties in climate change. I cannot say at this time that we have specific results. Many of these programs are ramping up very, very quickly, and I would expect to start yielding results in the five- to 10-year framework. We are reducing certain scientific—

Mr. RITTER. The results will start to come in after five and 10 years?

Dr. PATRINOS. I would think so.

Mr. RITTER. From now?

Dr. PATRINOS. From now.

Mr. RITTER. Just remember what happened to this Congress legislating on acid rain and NAPAP, the National Acid Precipitation Assessment Program. We basically had a 10-year — and I'm not arguing against long range planning; obviously, we have to do it—but we had a 10-year program started by Democrats President Carter and Daniel Patrick Moynihan, and basically we assiduously—the process here, the legislative process, assiduously avoided consideration of this monumental, nearly \$600 million study when we went ahead and forward legislating on acid rain.

Now, hopefully, we will not make the same mistake again, but thank you for your testimony.

Dr. PATRINOS. Thank you.

[Recess.]

Mr. SCHEUER. Well, we'll reconvene now, and I think we're through voting today, so we'll have an uninterrupted session. It's

always mortifying to me to have to keep busy people like you waiting while we trot over there and vote.

Mr. SCHEUER. All right. On this second panel, we'll have Dr. Richard Reba, Director of the Division of Nuclear Medicine at George Washington University Medical Center. Dr. Reba is representing the American College of Nuclear Physicians and the Society of Nuclear Medicine. Then we'll hear from Dr. Robert Corell, Chairman of the Working Group on Global Change for the Committee on Earth and Environmental Sciences of the Federal Coordinating Council on Science, Engineering, and Technology at the OSTP, the Office of Science and Technology Policy. Then we'll hear from Dr. David Reichle, Associate Director of Environment, Life, and Social Sciences at Oak Ridge National Laboratory at Oak Ridge, Tennessee.

Okay. We're delighted to have you. Why don't you each take five or six minutes, as has been our custom, and summarize your views. If you have a prepared statement, they will all be printed in full in the record at this point in time. Okay?

So please proceed, Dr. Richard Reba.

STATEMENT OF RICHARD REBA, DIRECTOR, DIVISION OF NUCLEAR MEDICINE, GEORGE WASHINGTON UNIVERSITY MEDICAL CENTER, WASHINGTON, D.C., REPRESENTING THE AMERICAN COLLEGE OF NUCLEAR PHYSICIANS AND THE SOCIETY OF NUCLEAR MEDICINE

Dr. REBA. Thank you, Mr. Scheuer. I appreciate the opportunity to appear again before you and your committee, not only on behalf of the organizations that I represent, but on a personal level as well.

We have submitted a prepared statement, and if you have no objections and would agree, we would appreciate the opportunity perhaps to amend it.

Mr. SCHEUER. Please do.

Dr. REBA. Thank you.

Mr. SCHEUER. We'll hold the record open for a week or 10 days, whatever you need to give us your final draft.

Dr. REBA. Thank you. I appreciate that.

In addition to being a professor of radiology and medicine at George Washington University, I practice medicine, but most of my professional efforts, I must tell you, are devoted to research, and that's my self-serving reason to be here to support the DOE budget proposal.

My research has been funded for more than 20 years by NIH and at least six or more years by the DOE, but on the other side of the issue, I also serve as a peer reviewer, and so I would like to let our prepared statement stand and address the issue that it appears you and the other members of your committee are mostly concerned with, and that is with the peer review process as it applies within DOE.

Mr. SCHEUER. Very good.

Dr. REBA. I also am a member of the HERAC committee, an active member of the HERAC committee, and have been serving as

a member of several of its subcommittees for the past several years.

It's my impression that—to answer one of your earlier questions—that both the intramural and extramural programs supported by the DOE do receive a review process, but like the recommendations of the HERAC committee, it's important to understand that these recommendations of these committees and peer reviews are advisory only. The HERAC committee advises through the director of the Office of Energy Research to the Secretary, but the HERAC committee responds to issues identified by the director of OER regarding issues of priority, issues of strategy, relative priorities, but not on individual research projects. And as all advisory panels, some of our advice is taken, some is not taken, but I do believe that it's always seriously considered.

The issue of peer review is important in the last several years, because almost all of the projects this year have the nuclear medicine projects; I can only speak to those—have been affected adversely by Congressionally mandated projects. In my view, there's no question about that. There's been some across-the-board reductions in projects, and there have been some projects that have been completely eliminated, sometimes abruptly.

Mr. SCHEUER. In other words, they've been squeezed out by the cumulative effect of all these Congressionally designated projects?

Dr. REBA. In my opinion, that's true. Some of these projects, I believe, are longstanding projects, I think they're important projects, that have been eliminated completely.

I wish I could illustrate not only the cost benefit, but cost effectiveness, programs that have resulted from DOE-supported research. I will tell about one briefly, because it involves not only a DOE-generated radioactive-labeled drug, but it deals with progress in eliminating unnecessary medical testing in women, which is now an important issue before many national groups and before Congress.

There's a drug called Thallium 21 that is used for thallium stress testing of the heart. This was developed by a group at Brookhaven, along with investigators at a DOE-supported lab at the University of California in Berkeley. They identified this form of radioactivity, they validated its use in heart testing. Before this test was applied in patients, about two thirds of middle-aged women—that is, women between the ages of about 40 and 60 or 45 and 65—two thirds of those women had coronary arteriograms, which is an invasive test—a catheter is passed into the body through the vessels into the heart, and a dye is injected into the heart—but the assessment of those women who needed that test was so poor that two thirds of those studies turned out to be normal. After the introduction of this thallium stress test, only about 20 percent of the coronary arteriograms were normal. Clearly, almost 50 percent of the women who received that test before 1975 didn't need it.

That's just one, I think, important example of the payoff of DOE-supported research in basic science. No one else could have done that work except people at the National Laboratories.

As a member of some study sections at NIH and the chairman of two study sections, I was involved peripherally, but involved, in their examination of the peer review process. As Congressman

Ritter stated, there are other ways to set priorities, but a better one has not been identified, and it's a process that has to be continued. I was personally heartened by your comments at the open, and I would tell you although I have not had a chance to discuss this with the organizations that I represent, but I know intuitively—and I believe wholeheartedly in your proposal that Mr. Ritter supported—that not only construction projects, but all operations, all projects, be subject to peer review. It's really the only way that science can survive and continue to produce these kinds of results that we've been able to do, not only in medicine, but outside of medicine as well, in all of science and technology advancement.

Congressman Morella—

Mr. SCHEUER. It is particularly true in a time of fiscal constraints.

Dr. REBA. Absolutely. Absolutely.

Mr. SCHEUER. There may have been days when we thought we could do everything and we could fund every proposal for scientific research, and let's see which of them worked, and some of them would fall by the wayside and not prove very productive, but in a time where we have far more applications than we have funding, then we have to be selective about those that we fund, and we want to make sure that we fund the most promising. To my mind, peer review is absolutely quintessential.

Dr. REBA. We would support that position wholeheartedly, unequivocally, and absolutely. It's important, I think, though, as you convince your other members of not only your committee, but of Congress, that high-priority research projects that have a high probability of payoff usually are associated with some risk. That concept extends beyond medicine. Big payoff, big risk. And so projects with high risk, there is no guarantee of their success. There is going to be some failures, but that should not be taken as some evidence that the system is not useful and should not work.

Let me just close and leave some time for questions by responding to Congressman Morella's question about what Congress could do. Again, this is my personal view, that your solution is the correct one, that, in other words, it must be legislated. It will not work unless peer review is mandated by Congress.

The NIH model is a good one. Some members of Congress have tried to fund individual research projects through NIH money, and fortunately for the system, they have been unsuccessful so far. You've got to set up those same constraints for DOE, and let me just close and wish you well in your project, and I'll be happy to answer any questions for you.

[The prepared statement of Dr. Reba follows:]

ACNP

American
College of
Nuclear
Physicians

1101 Connecticut Avenue, N.W. • Suite 700 • Washington, D.C. 20036

202-429-5120

SNM

The Society
of Nuclear
Medicine

STATEMENT OF
THE SOCIETY OF NUCLEAR MEDICINE
and
AMERICAN COLLEGE OF NUCLEAR PHYSICIANS
concerning the
DEPARTMENT OF ENERGY'S FISCAL YEAR 1992 BUDGET
for the
MEDICAL APPLICATIONS PROGRAM
submitted to the
HOUSE OF REPRESENTATIVES
SCIENCE, SPACE AND TECHNOLOGY SUBCOMMITTEE
on
NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

March 21, 1991

The Society of Nuclear Medicine (Society) and the American College of Nuclear Physicians (College) are pleased to offer the following statement regarding the Department of Energy's Fiscal Year 1992 budget. Together, the Society and College represent over 14,000 physicians, physicists, chemists, radiopharmacists, technologists and other professionals engaged in nuclear medicine research and clinical practice.

The Administration's Fiscal Year 1992 budget proposal seeks \$33,900,000 for the Department of Energy (DOE) Medical Application Program. Over the past decade, the budget for the DOE Medical Applications Program has been flat or declining. The College and Society recommend a funding level of \$42,135,000 or an annual increase of 6% from FY 1989. The College and the Society are very concerned with the bypass of scientific peer review in advancing scarce funds for medical research. The Department of Energy's (DOE) Medical Applications Program has been highly productive and has contributed significantly to new and improved technologies for diagnosing and treating cancer, heart disease, stroke, Alzheimer's disease, epilepsy, bone disease and other illnesses.

For the past several years, the nuclear medicine community has urged increases in the DOE Medical Applications Program to counter the previous stagnant funding levels and to facilitate promising research which is based on competitive scientific review. For fiscal year 1991, the DOE was directed to make available \$89,842,500 to ten medical research facilities for non-peer reviewed projects; two of the programs had previously been specified as recipients of \$10 million each for FY 1990. By comparison, the DOE Medical Applications

Program received \$36,800,000 in 1991, a 2.2% decrease from \$37,645,000 in 1990. As a result of the tendency to refund existing research programs, bypassing peer review, with no additional appropriations to accommodate programmatic directives of the Medical Applications Program budget, there has been insufficient funding to support the base nuclear medicine research program where innovative research projects originate.

The Society and College strongly urge Congress to reaffirm commitment to the traditional peer review process in awarding federal research funds. Congress has also bypassed peer review. The fiscal year 1990 and 1991 appropriations included \$7.5 million and \$5.5 million respectively for the Boron Neutron Capture Therapy (BNCT) research program at the Idaho National Engineering Laboratory (INEL). Previously, the BNCT had received unfavorable peer review by a panel of the National Cancer Institute (NCI). In addition, for FY 1991, \$7.5 million was appropriated for the modification and operation of the Power Burst Facility (PBF) at the INEL.

In April, 1990, a Subcommittee of the DOE's Health and Environmental Research Advisory Committee (HERAC) released a report on the BNCT. The Subcommittee concluded that, at present, BNCT would offer no gain over standard modern radiotherapy techniques and believed that there was no evidence to support the conversion of the PBF to a clinical facility. They stated that conversion of the reactor for medical use should not occur and that the reactor should no longer be maintained in a standby state for medical purposes.

The Society and College believe that mandating funds for non-peer reviewed projects, or projects which receive negative peer review, not only undermines the scientific peer review process, but also is contrary to recommendations made by committees of distinguished experts whose counsel and evaluation of Boron Neutron Capture Research was sought by the DOE and by the National Institutes of Health.

The College and the Society support the recommendations presented in an August, 1989 report on DOE's Nuclear Medicine Program, prepared by a HERAC Subcommittee. The report was prepared in response to a request for an assessment of DOE's Nuclear Medicine Program, including "...its conceptual basis, and its relationships with the nuclear, medical and radiopharmaceutical efforts and needs in the public and private sector." The Subcommittee on Nuclear Medicine Research summarized specific recommendations to be considered by DOE for planning purposes, including the use of the peer review process in the assessment of research projects. According to the HERAC report, "...some research projects of relatively low merit have been supported too long. The Subcommittee recommends that the policy to peer review all research projects, both intramural and extramural, at least every five years be continued."

We believe this Committee should encourage DOE to initiate a process to assure that funds appropriated for medical research are granted to peer reviewed projects. We also urge this Committee to express its support for the traditional peer review process in the awarding of DOE research funds. Peer review ensures that scientific projects are reviewed competitively by a jury of the applicant's peers and helps to ensure that public funds are spent judiciously.

The Society and College urge this Committee to take a leadership role in demanding accountability in the DOE's Medical Applications Program, including DOE budgetary information detailing how the Medical Applications Program budget is allocated. The support for radionuclide production, radiopharmaceutical development, imaging devices and radionuclide therapy categories is very modest. Support for this portion of the nuclear medicine research program must be maintained over the long term and should be expanded over the short term.

DOE's Medical Applications Program, designed to enhance the applications of both radioactive and stable isotopes, has contributed significantly to the health care delivery system in the United States. In order to continue the progress achieved in the field of nuclear medicine, it is imperative that funding for research efforts not be appropriated without scientific peer review. We are confident that you will ensure that funds for medical research are responsibly mandated. We are most appreciative of the opportunity to express our concerns on this matter to you.

Mr. SCHEUER. Very good. I understand you are under some time constraints now.

Dr. REBA. I am a little. Thank you.

Mr. SCHEUER. Why don't I ask you—I just have a couple of questions to ask you.

Dr. REBA. Sure.

Mr. SCHEUER. The first is—the first comment, really, is that the subcommittee has heard a great deal of criticism from some scientists that it's very difficult for a researcher not already receiving DOE funds to obtain a grant. In other words, it's tough to break into the club if you ain't already a member. Now, is there truth to this criticism? Can you comment on that?

Dr. REBA. That was probably true 10 years ago, but during the last 10 years that has become less and less so. I cannot give you those data, but I'm sure there are people from DOE headquarters that can provide you with the numbers of the new individual research—new investigators that they have funded, and I will tell you that that was the result of a special subcommittee that they appointed to look at their—“they” being DOE—to look at their program and look at those programs that should be discontinued and phased out so that money could be made available to new projects.

I, for example, have only gotten my DOE support for about six years. Before that, it was very, very difficult. But I think their philosophy is changing.

Mr. SCHEUER. That's good. All right. Now, you, as a member of the Health and Environment Research Advisory Committee, have said that you believe the committee meets often enough and conducts peer reviews that are thorough enough to meet commonly accepted standards for peer review. You said that, right?

Dr. REBA. I think under the current process of how we operate, that's true.

Mr. SCHEUER. Well, do you have any suggestions for improvement? Are there any areas that you could identify that could use some shaking up?

Dr. REBA. I think there are, and I think the chairman of the HERAC committee, Dr. Wolf—Sheldon Wolf—I'm told has already begun some discussions with Dr. Decker's office, with Dr. Galas, about some suggestions on how the process could be improved. I'd prefer not to comment at this time, because I think those negotiations are new and are ongoing. But there are some suggestions being made directly to the DOE.

Mr. SCHEUER. All right. Dr. Reba, in your opinion, is it fair to say that in general research conducted intramurally — at your laboratories, for example—that they do not receive the same level or quality of peer review as does extramural research funded through competitive grants? Is there sort of a presumption that the projects that come from inside the shop, so-called, are pretty good projects, and they don't get quite the depth or intensity of peer review that an extramural project would get?

Dr. REBA. My projects with DOE would be considered an extramural project, but I would think what you stated—there is a perception that that is so. I'm not convinced it's true, but yes, that perception exists.

Mr. SCHEUER. Would it be a legitimate practice if it did exist? In other words, would there be sort of a barely debatable presumption that if it came from inside the family, it's probably a good project and doesn't need as intensive peer review?

Dr. REBA. No, I think my reasoning would be a little different. My reasoning is that the country, the Government, has an investment in the National Laboratories to keep them going, to keep them operating, and given their history, they have been continuously productive. They've had their success years and their not-so-success years, but that's the way life is.

Mr. SCHEUER. Sure.

Dr. REBA. And I think our investment is so great in those National Laboratories, the payoff has been consistently so good, that they should continue to be funded with scrutiny that is high, that is severe, that is intense, but maybe a little different than for extramural funding.

Mr. SCHEUER. All right. We promised to get you out of here by 3:15, and it's 3:15 on the button.

Dr. REBA. Thank you. I appreciate it so much.

Mr. SCHEUER. We're very grateful to you for your time in coming here, and we appreciate your testimony.

Dr. REBA. Thank you.

Mr. SCHEUER. Okay. Now we'll hear from Dr. Robert Corell, Chairman of the Working Group on Global Change.

Please proceed, Dr. Corell.

STATEMENT OF ROBERT W. CORELL, ASSISTANT DIRECTOR FOR GEOSCIENCES, NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C., REPRESENTING THE COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES OF THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY

Dr. CORELL. Mr. Chairman, it's a delight and a pleasure to be with you today to talk about the policies and practices that we use within the CEES family to develop and implement the U.S. Global Change Program. What I thought I'd do is outline some of those procedures for you—

Mr. SCHEUER. Is that CEES or—

Dr. CORELL. Yes, CEES.

Mr. SCHEUER. Yes, the Committee on Earth and Environmental Sciences, for our reporter.

Dr. CORELL. Thank you. There's a fairly complete description in the prepared text, but I thought I'd just go over some of the general characteristics of the machinery, if you will, that we have developed over the last several years to address the issues that are important to this particular hearing.

As you know, the Global Change Research Program here in the U.S. has been developed by and is coordinated through this Committee on Earth and Environmental Sciences, which is a part of the FCCSET process of the Executive Branch. There are 18 agencies and offices that participate in the CEES, so we have a rather broad level of participation within the Federal Government.

But from the very beginning, the U.S. Global Change Program has been conceived in a fashion that it had to be guided by a set of

priorities that really address high scientific level questions that allow us as a Nation to move aggressively to understand global change and to lend our hand to the national and international policy process. In so doing, we've tried to reach across the Government to develop an integrated effort. We've established a clear and formal relationship, both domestically and internationally, with the scientific community to afford ourselves the access to, as we call it at NSF, the merit review process, through the National Academy of Sciences and through the International Academy of Sciences, which is called the International Council of Scientific Unions. We have also linked ourselves to the United Nations bodies and, more recently, to our counterparts in other agencies in foreign lands pretty much throughout the world.

So how do we get at this issue of peer review? Your question to us to come and speak to you helped us think in a more encompassing fashion about what we do. We have had what I would call a multi-level set of peer and priority review processes at the strategic level. We work closely with our partners, both domestically and internationally, in the scientific community. We established special panels so that the overall goals and objectives are, in a sense, peer and merit reviewed. If you look at our goal statements, if you look at our overall objectives, if you look at the series of scientific questions that we are trying to address, these have all been vented through a peer and merit review process so that the total program, if you will, is subjected to a sort of strategic review.

At the programmatic level, looking across the agencies at modeling programs, at CO₂ programs, et cetera, we rely on a whole series of sets of machinery ranging from the National Academy of Sciences to special advisory panels. As Dr. Patrinos mentioned, the JASON Group has helped us immensely on a number of fronts. So at the programmatic level, before we actually get to specific projects, we have another level of review, which is intended to ferret out excellence and be certain that the program is only addressing those kinds of questions that require resources of the Federal Government.

Then at the project level, I think Dr. Patrinos has given you a good view. It's characteristic not only of the Department of Energy, but of other agencies as well—a multi-level set of peer review/merit review machinery is used to be sure that the projects are in place.

So from an overall perspective, we have a framework. As I indicated in the written text, we've used agreed-upon overall goals as measures to be certain that the projects are focused. We have a multi-level set of priorities and program structures that allows us to allocate resources in accordance with the driving scientific questions. We've developed a set of agency roles and role statements to guide ourselves as we work across agency lines to be sure that gaps are filled, but overlaps are clearly not a part of the program. We have some very specific evaluation criteria that allow us to function. All of these work together, we believe, so that we can fund, through the agencies, high-priority components of the Global Change Program, and that these do in fact fit within the budget envelopes that are available to this particular program.

As you may recall, we're trying to do three things: we're trying to, over the long haul, establish an integrated and comprehensive long term program of documenting the Earth system on global scales; secondly, we're trying to understand the key processes, not only the natural sciences, but those in the social sciences as well, because they are really what drive our interest in global change—that is, anthropogenic aspects; and finally, our goal is to better understand and to predict how the Earth system operates. The reason I took a minute to read those off to you is these scientific objectives were jointly agreed to not only by all the agencies who agreed to every word therein, but through the National Academy of Sciences, who also agreed that those are appropriate objectives for a national effort addressing global change.

In the written testimony is our three-level set of priorities that address strategic issues of separating out anthropogenic aspects from natural variability, one of the fundamental issues that we have to address no matter what we do. We believe that our research has to address that question and others of that ilk. We have what we call integrating priorities, that is, the key scientific goals that we're trying to address. Every single project must address at least one, and hopefully more than one.

And then, in a rash moment, we thought it would be useful to try to articulate scientific priorities and, early on, Mr. Chairman, this was very contentious. It was the first time a group had said, "Look, here are scientific priorities that if you rank them in this way, you've got a good chance of getting to the heart of the global change issue." And not only did the agencies eventually, after a great deal of conversation, agree to this framework that was developed within the scientific community and the agencies, but the National Academy of Sciences fully endorsed this as a working framework. Now we have a document that allows us to think about the high-priority areas, and, therefore, it helps us when we come to resource allocation.

Dr. Patrinos also mentioned some evaluation criteria, and here is where the merit review aspects of our program come to bear. On page 6 of the written text, there's a table that shows these. No project finds its way into the program without having addressed these issues, and there is machinery within the committee, Mr. Chairman, that works at virtually all levels of the agencies, from the program people who have to live with the decisions and participate in the actual funding of research projects, both internally and extramurally, all the way to the heads of the agencies, who approve everything that we undertake. These are the criteria that we apply.

Every project must have demonstrated relevance and contribute to the goals, objectives, and purposes of the total program, there's a careful review to ensure that happens. The next has to do with scientific merit. The proposed work must be scientifically sound and of high priority, and, specifically, the proposed program or activity must be the product of an agency, interagency, or international scientific planning and review process that is documentable to OMB. That's an agreed-upon system that we work with, within the CEES process.

There are a number of others that relate to the evaluation criteria. The program must be ready; it has to be demonstrably able to meet its objectives; wherever it is appropriate, and we believe in most cases it is, linkages to other agencies, to other international partners, must be demonstrated, be in place and ready to go; we look carefully at the cost issue, and I can assure you—and the agencies know full well—that the committee will evaluate the total cost, and our recommendations of the committee to the OMB are often different from the recommendations of the agencies. Early on, there were wide differences between the agency recommendations and ours, but when that budget goes to the OMB on September 1, those differences have all been resolved, and our recommendations and the agencies are coherent. We look carefully at the cost issue, and I think you'll find that the recommendations of the CEES with respect to the cost issue has been a consistent part of our effort.

—I could go into some detail as to the machinery, but I think I'll let that go, unless you have some questions about it. I think I'll leave it there—

Mr. SCHEUER. Why don't you submit the detail for the record, and we could get on to Dr. Reichle and then ask some questions.

Dr. CORELL. Yes. Fine. That would be fine by me. We'll stop there. Thank you, sir.

[The prepared statement of Dr. Corell and the requested detail follow:]

STATEMENT OF
ROBERT W. CORELL
ASSISTANT DIRECTOR FOR GEOSCIENCES
NATIONAL SCIENCE FOUNDATION
REPRESENTING
COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES
OF THE
FEDERAL COORDINATING COUNCIL FOR
SCIENCE, ENGINEERING, AND TECHNOLOGY
BEFORE THE
SUBCOMMITTEE ON ENVIRONMENT
OF THE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
MARCH 21, 1991

Mr. Chairman and Members of the Subcommittee, it is a pleasure to appear before you today to discuss the policies and practices used by the Committee on Earth and Environmental Sciences (CEES) to develop and implement the U.S. Global Change Research Program (US/GCRP). I am here today in my capacity as the Chairman of the Working Group on Global Change of the CEES. What I plan to do is to outline the manner in which CEES functions, with a particular emphasis on the policies, practices, and methods of operation for the CEES Working Group on Global Change. Thank you for the invitation to testify and outline some of our activities. We appreciate this opportunity.

CEES PROGRAM AND BUDGET DEVELOPMENT STRATEGY

The U.S. Global Change Research Program has been developed through, and its coordination guided by, the Committee on Earth and Environmental Sciences and its Working Group on Global Change. The CEES plays a vital role in the development of a global change research program that contributes to and supports the U.S. policy process for global environmental issues. Eighteen Federal agencies and offices participate in the CEES process to coordinate a US/GCRP. The CEES links into the overall U.S. global change strategy through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), of which it is a part. The US/GCRP is driven by carefully established priorities associated with the key scientific questions that must be addressed to establish sound national and international policies related to global environmental issues such as global climate change and ozone depletion. The Program was developed as a Government-wide, integrated research effort. Further, the CEES has established the

Program in cooperation with the U.S. and international scientific communities, through the National Academy of Sciences (NAS) and the International Council of Scientific Unions (ICSU). The Program is also linked internationally to United Nations intergovernmental organizations, such as the World Meteorological Organization, and to a substantial number of foreign government agencies through the International Group of Funding Agencies for Global Change Research (IGFA).

A little over three years ago, it was recognized that an effective response to the potential impacts of global environmental change required a focused, well-coordinated commitment by U.S. Federal agencies. Agency scientists and program managers, as well as government leaders in the Executive Office of the President, realized that an integrated program of global change research was essential. With strong support from the national and international scientific communities, the Federal agencies, under the auspices of the White House Office of Science and Technology Policy's Committee on Earth and Environmental Sciences, formally established the U.S. Global Change Research Program (US/GCRP) as a Presidential Initiative in the FY 1990 Budget.

During the past three years, the CEES Working Group on Global Change has developed an integrated and priority-driven framework to guide the development of the U.S. Global Change Research Program. The CEES agencies have approved a framework which includes:

Framework for Developing the US/GCRP

- An Overall Goal for the Program;
- Three Parallel Scientific Objectives;
- A Set of Science Priorities to Structure Program Development;
- A Set of Program and Project Level Evaluation Criteria;
- A Set of Agency Roles; and
- Terms of Reference for CEES Program and Budget Planning.

This framework is an essential part of the overall program and budget development

strategy of the CEES and provides the continuing structure within which CEES evaluates and develops:

- (1) the essential, high priority components of the US/GCRP in each fiscal year; and,
- (2) the recommended budgets to support those critical components.

The overall goal of the U.S. Global Change Research Program is:

Goal of U.S. Global Change Research Program

To gain a predictive understanding of the interactive physical, geological, chemical, biological, and social processes that regulate the total Earth system and, hence, establish the scientific basis for national and international policy formulation and decisions relating to natural and human-induced changes in the global environment and their regional impacts.

To fulfill this goal, the CEES Federal agencies and offices are collectively implementing multi-disciplinary programmatic activities which address the Program's three parallel scientific objectives:

Scientific Objectives of the U.S. Global Change Research Program

- To establish an integrated, comprehensive, long-term program of documenting the Earth system on a global scale;
- To conduct a program of focused studies to improve our understanding of the physical, chemical, biological, geological, and social processes that influence Earth system processes and trends on global and regional scales; and
- To develop integrated conceptual and predictive Earth system models.

Work towards these objectives proceeds simultaneously and in concert since progress in each influences the others.

The structure of the US/GCRP draws upon the strengths of existing, fundamental disciplines while also building the interdisciplinary scientific approaches that an integrated Earth system sciences research program demands. The Program's seven science elements -- the basic framework for priority-setting -- reflect the integrated and interdisciplinary nature of such a complex research effort. These science elements are:

Science Elements of the U.S. Global Change Research Program

- Climate and Hydrologic Systems
- Biogeochemical Dynamics
- Ecological Systems and Dynamics
- Earth System History
- Human Interactions
- Solid Earth Processes
- Solar Influences.

A Set of Program and Science Priorities

The seven science elements, outlined above, formed the basis for the development of a priority-setting framework, used by the CEES Working Group on Global Change to structure the overall balance of research emphasis and scope of activity. The US/GCRP draws upon the strengths of existing, fundamental disciplinary science to develop the interdisciplinary scientific approaches that an integrated earth sciences research program demands. To field an effective array of scientific studies, there needs to be a priority-setting framework for the allocation of resources: financial, human, and facilities infrastructure. The CEES developed and has implemented a multi-level priority-setting framework (Depicted in the Figure on the Next Page) that is used to focus and integrate program development and budget proposals for the annual budget process. This framework contains three levels of priorities to be met in developing a US/GCRP. These priorities are designed to ensure that the Program makes rapid progress toward resolving the most significant uncertainties. It is a framework to address those research questions which, if addressed effectively, would produce significant early improvements in our ability to understand and make predictions for assessment purposes of the interactive Earth system. Concurrent progress in high priority activities in all science elements is necessary for the US/GCRP to achieve its overall goals.

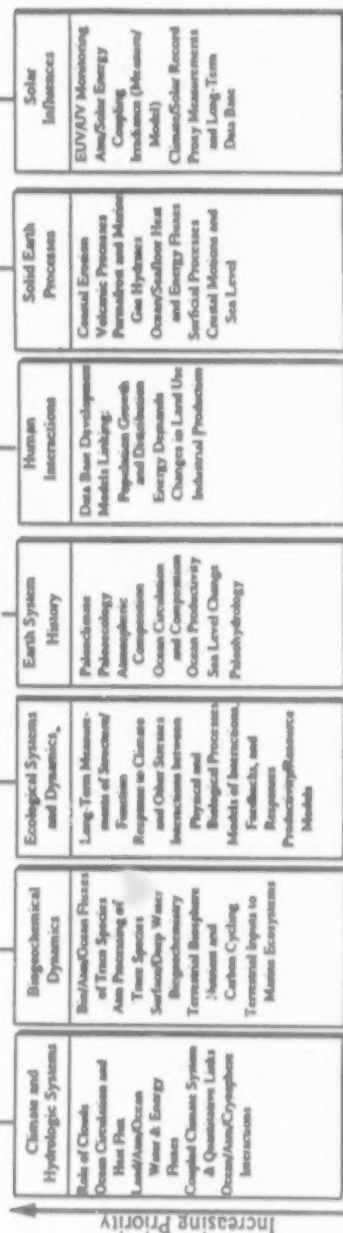
STRATEGIC PRIORITIES

- Support Broad U.S. and International Scientific Effort
- Identify Natural and Human-Induced Changes
- Focus on Interactions and Interdisciplinary Science
- Share Financial Burden, Use the Best Resources, and Encourage Full Participation

INTEGRATING PRIORITIES

- Documentation of Earth System Change
 - Observational Programs
 - Data Management Systems
- Focused Studies on Controlling Processes and Improved Understanding
- Integrated Conceptual and Predictive Models

SCIENCE PRIORITIES



U.S. Global Change Research Program Priority Framework

A Set of Program and Project Level Evaluation Criteria

Building on the scientific priority-setting framework, the CEES Working Group established specific set of Evaluation Criteria to guide the evaluation of individual agency proposals.

CEES Evaluation Procedures and Criteria

- **Relevance/Contributions:** The research must address the overall goal and one or more of the three scientific objectives of the US/GCRP as well as contribute to the more specific questions identified in the FY 1992 Budget Strategy;
- **Scientific Merit:** The proposed work must be scientifically sound and of high priority. Specifically, the proposed program or activity must be the product of a documented agency, interagency, or international scientific planning and review process that is demonstrable to OMB;
- **Readiness:** The level of planning must be high, the capabilities of high quality and in place, and the research likely to produce early advances;
- **Linkages:** The CEES will look for national and international connections, including interagency partnerships, to be in place.
- **Costs:** The CEES will consider whether the identified resources are adequate; if they represent an appropriate share of total available resources (e.g., an appropriate balance between space-based and ground-based program elements); prospects for joint funding; and the degree to which long-term resource implications have been evaluated.
- **Enhancements to Existing U.S. Global Change Research Programs:** If research activities equally meet the above criteria, enhancements to approved elements of the Program as broadly defined in the President's FY 1991 Budget will be addressed before new initiatives are funded. This will ensure that the highest-priority existing programs will receive adequate support;
- **Agency Approval:** The proposed program or activity must be reviewed by the submitting agency and have policy-level approval by the agency as an FY 1992 contribution to the US/GCRP.

A Set of Agencies Roles

The CEES, early in the development of the US/GCRP, felt it was critical to review the role each agency would play in the implementation of the US/GCRP. The result of that assessment is a set of agency role statements, each of which was approved by all agencies, and by the appropriate Executive Offices of the President. These provided a basis for focusing research efforts and avoiding gaps and overlaps. These role statements are contained in Appendix A.

Terms of Reference for CEES Program and Budget Planning

Further, the CEES, in applying this program and budget development framework, works within guidelines set by Terms of Reference (TOR) issued by OMB. These Terms of Reference are endorsed by all CEES agencies and provide a "contract-like" relationship among the three critical parts of the budget development process (i.e., the Executive Offices of the President through OMB and OSTP, the CEES, and the participating agencies of the CEES). The TOR sets forth the specific responsibilities for CEES, the participating agencies, and the OMB/OSTP. This framework enables CEES to develop and recommend a U.S. Global Change Research Program which identifies the highest priority program elements required to support the most critical U.S. global change policy interests.

An Outline of the Annual CEES Program and Budget Development Process

The annual US/GCRP program and budget development process begins within each of the participating agencies, often many months before the formal CEES process begins in late spring of each year. The principal steps in the annual CEES program and budget development process are summarized as follows:

CEES Program and Budget Process

- * Agencies are invited to initiate the annual CEES US/GCRP budget process by recommending specific program proposals to the CEES early in the annual Federal budget development process.
- * The TOR requests that these agency project and budget recommendations to the CEES must clearly and directly support the goal, objectives and research priorities for the US/GCRP.
- * CEES conducts a thorough review of all project and budget recommendations, using the program and budget development framework outlined above, to determine the specific agency project recommendations that clearly contribute to a scientifically balanced program. CEES US/GCRP budget recommendations must not only fit these criteria, they must fit within the OMB provided budget envelope. To do this, the CEES employs about twelve different Task Groups of agency scientists who conduct the actual review. Based on the results of these Task Group reviews, the CEES Working Group then develops a series of program and budget options that provides OMB and OSTP with an integrated US/GCRP that fit within available resources. The CEES then develops a specific strategy for the next five year period (i.e. FY 1993-96). These CEES recommended options are approved by all the CEES agencies prior to submission to OMB. Further, agency budget submitted for US/GCRP projects and those recommended by the CEES are the same and hence fully consistent with each other. The final CEES option recommendations are submitted to the OMB review on September 1 of each year.
- * In developing the annual President's budget to Congress, OMB and the CEES agencies make the final funding decisions which identifies an overall Government-wide funding proposal to the Congress for the US/GCRP.

Implementing the Program Development Strategy for FY 1992

Each year, in addition to the generic program and budget review procedures outlined above, the CEES establishes a specific strategy for the development of the next fiscal year budget. The specific objectives for the development of the FY 1992 President's budget submittal to the Congress were designed to take advantage of new knowledge and an increased understanding of the current national and international needs for global change research. The FY 1992 budget strategy set two overall goals and objectives, which relied on the results of the Scientific and Impacts Assessment of the Intergovernmental Panel on Climate Change (IPCC), including:

FY92 Goals and Objectives

- (1) Enhance scientific research efforts to reduce the scientific uncertainties identified during the IPCC scientific (Working Group 1) and impacts assessments (Working Group 2), specifically:
 - sources and sinks of greenhouse gases, which affect predictions of future concentrations;
 - clouds and radiative balance, which strongly influence the magnitude of climate change at global and regional scales;
 - oceans, which influence the timing and patterns of climate change;
 - land-surface hydrology, which affects regional climate change and water availability;
 - polar ice sheets, which affect predictions of global sea level changes; and
 - ecological dynamics, which are impacted by and respond to climate change.
- (2) Enhance scientific research to address greenhouse gases comprehensively, rather than on a gas-by-gas basis. Priorities include:
 - sources and sinks of greenhouse gases;
 - development of a quantitative index of radiative forcing; and
 - development and use of economic models to generate predictions and scenarios that cover multiple greenhouse gases and multiple economic sectors.

The FY92 Budget Strategy

Planning for the FY 1992 US/GCRP, as in previous years, has been guided by the extensively reviewed strategic, integrating, and scientific priorities of the planning framework (See Figure on page 5), the evaluation criteria, and the other elements of the Framework. The results of the IPCC scientific and impacts assessment were utilized in further developing the US/GCRP to ensure that the Program is responsive to the highest priority global change policy issues. The proposed FY 1992 US/GCRP budget reflects:

- (1) A balance among the scientific objectives;
- (2) A continuing commitment to both establish an integrated, comprehensive (space- and ground based) atmospheric, ocean, and terrestrial observing system, which will acquire the long term databases necessary for the development and testing of predictive models and for global change monitoring, and to conduct focused studies to improve the understanding of key processes that control the global earth system;
- (3) A strong commitment to an augmentation in climate modeling and prediction; and
- (4) A broader understanding of the potential consequences of global environmental change, its causes, consequences, and possible responses, through an expanded exploration of a broad range of economics research.

Using the information needs identified by the IPCC as a guide, four high priority Integrating Themes were adopted for the FY 1992 Program. Addressing these themes requires research in most of the seven science elements (including Human Interactions) and, therefore, provides an enhanced level of integration for the Program. These FY 1992 Integrating Themes allow the CEES agencies to focus the collective effort of government and academic scientists, in collaboration with scientists from other countries, on a number of high priority, multi-disciplinary investigations which respond to some of the current critical information needs in global change. The four FY 1992 Integrating Themes are:

- (1) **Climate Modeling and Prediction:** To develop an improved predictive capability of the Earth as a coupled system with enhanced regional resolution, with initial priority given to the climate system;
- (2) **Global Water and Energy Cycles:** To improve the understanding of the water (precipitation, evaporation, evapotranspiration, soil moisture, ice quantity, type and movement) and energy cycles (warming/cooling, radiative balance, solar variability, latent heat), by focusing on the:
 - **role of clouds:** primarily the role of water vapor and cloud formation – dissipation and radiative properties;

- **role of the oceans:** the exchange of energy and mass (e.g., water) between the ocean, sea ice, and the atmosphere: between the upper layers of the ocean and the deep ocean; and transport within the ocean;
 - **role of terrestrial ecosystems:** the exchange of energy and water balance between the atmosphere and the surface of managed and natural terrestrial ecosystems and soils; and
 - **change in sea level:** sea level changes are an integrated earth system response to changing climate conditions. Studies will examine the role of polar ice sheets, thermal expansion of the oceans, and the melting of land glaciers.
- (3) **Global Carbon Cycle:** To improve the understanding of the carbon cycle, by:
- quantifying the natural and anthropogenic terrestrial and oceanic sources and sinks of key carbon compounds (e.g., carbon dioxide, methane and ozone precursors such as carbon monoxide and the non-methane hydrocarbons), including their chemical reactions in the atmosphere and oceans; the chemical, biological and physical processes that control their fluxes; how these fluxes may be influenced by climate change; and how changes in greenhouse gas abundances affect the magnitude and rate of change.
- (4) **Ecological Systems and Population Dynamics:** To improve the capacity to assess the effects of global change at regional scales. Specifically, to improve understanding of the responses of intensively managed and natural oceanic and terrestrial ecosystems to global change by focusing scientific research on:
- species composition of ecosystems;
 - distribution and extent of ecosystems; and
 - productivity of ecosystems.

The four Integrating Themes for FY 1992, and the agency projects which support them, do not, however, represent the US/GCRP in its entirety. While these Integrating Themes provided a principal focus for major funding enhancements in FY 1992, the President's Budget request also includes substantially enhanced resources to support economics research related to global change, and resources to maintain programmatic momentum in a number of other critical US/GCRP investigations. These include continued support for investigations in the areas of stratospheric ozone, human interactions, solid earth processes, and solar influences.

Summary

The CEES Working Group on Global Change has sought to develop and implement a set of policies, procedures, and practices that guide the annual review and development of the U.S. Global Change Research Program and budget. The process is designed to develop an integrated and well-balanced Global Change Research Program that evolves from the need to dramatically increase our understanding of earth system processes and which adequately supports the policy process in the U.S. and abroad. Ultimately, the process outlined in this testimony is designed to address the overarching goal of the US/GCRP which explicitly states that the Program should "... establish the scientific basis for national and international policy formulation and decisions relating to natural and human-induced changes in the global environment and their regional impacts."

APPENDIX A: AGENCY ROLES

AGENCY AND ORGANIZATIONAL ROLES

At the outset of the Program (US/GCRP), the CEES developed a set of role statements that specifically define each agency's respective role in the Program. The roles of agency participation in the program falls into two broad categories:

- (1) Agencies whose budget initiatives are in the "focused" category and hence are detailed in all the CEES US/GCRP budget documents. These are the Department of Commerce, National Oceanic and Atmospheric Administration, The Department of Defense (including the Office of Naval Research, the Oceanographer of the Navy, Army Corps of Engineers) Department of Energy, Department of the Interior, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, The Smithsonian Institution, and the United States Department of Agriculture. The role statements for the agencies and organizations follow on pages A-2 to A-4.
- (2) Agencies and Offices of the Executive Branch that contribute to the overall guidance of the Program. These agencies and offices contribute to the architecture of the Program and are key vehicles for coordinating and linking the Program with overall national and international policy interests in global change. These include the Council on Environmental Quality, Departments of State and Transportation, Office of Management and Budget, Office of Science and Technology Policy, and the White House Office of Policy Development.

Department of Commerce - National Oceanic and Atmospheric Administration

NOAA maintains a balanced program of observations, analytical studies, climate prediction and information management in the national global change program. NOAA will be responsible for: operational *in situ* and satellite observations and monitoring programs; mission-directed research on physical and biogeochemical processes in the climate system (including their effect on marine ecosystems and resources); development, testing, and application of models and diagnostic techniques for the detection and prediction of natural and human-induced climatic changes; and the acquisition, maintenance, and distribution of long-term data bases and related climate information.

Department of Defense

DOD conducts mission-related research into environmental processes and conditions that affect defense operations, tactics, and systems. DOD research programs contribute information that is useful in focused global change programs of other agencies; other agencies' programs similarly produce results that are useful to DOD's mission-related research programs. DOD participates in global change program planning and collaborates with other agencies in global change data management in order to ensure effective coordination and transfer of information between DOD and civilian agency programs.

Department of Energy

DOE shall conduct research on carbon dioxide and other emissions from energy supply and end use systems. The research shall include the climate's response to those emissions and shall develop the base of scientific information necessary to assess the climate's response assuming various energy and industrial policies. Associated efforts may include, but not be limited to, research to quantify the relationships between carbon dioxide and other trace gases and temperature rise, assessment and application of predictive models, evaluation of global and regional climate and environmental responses to various energy policy options, and research on industrial sources of trace gases. Research may include all causes of climate change and how possible responses to change could affect energy options.

Department of the Interior

DOI program efforts address the collection, maintenance, analysis, and interpretation of short- and long-term land, water, biological, and other natural resource data and information. Such efforts include, but are not limited to, monitoring of hydrologic and geologic processes and resources, land use, land cover, and biological habitats, resources, and diversity. Some DOI research areas include: past global change recorded in the physical, chemical, and biological record; the hydrologic cycle; land-surface and solid Earth processes that relate to environmental change; geography and cartography;

APPENDIX A: AGENCY ROLES

polar and arid region processes; ecosystem modeling and dynamics; resource ethnology. The Department utilizes knowledge developed in these and other agencies' programs to evaluate and when necessary respond to potential effects of global change on water, land, biological, and other natural resources.

Department of Transportation

DOT maintains awareness of the impact of transportation on global change. That impact occurs primarily through the use of fuels in transportation systems, resulting in the emission of combustion gases, including aircraft emission, into the stratosphere. DOT must also be aware of how climate changes affect the efficiency and safety of transportation on land, sea, rivers, and in the air.

Environmental Protection Agency

EPA conducts research to assess, evaluate and predict the ecological, environmental, and human-health consequences of global change, including the feedback of these systems on climate change. Additional areas of activity include research to determine emission factors, and inventories and models for radiatively important trace gases, and research to predict the interactions between global atmospheric change and regional air and water quality.

National Aeronautics and Space Administration

NASA is responsible for Earth science research from space, including those studies of broad scientific scope that study the planet as an integrated whole. Associated efforts include related process studies; sub-orbital and ground-based studies; remote-sensing and advanced instrument development; improvement of techniques for the transmission, processing, archiving, retrieval, and use of data; related scientific models; and other research activities in atmospheric, oceanographic, and land sciences.

National Science Foundation

NSF is responsible for maintaining the health of basic research in all areas of Earth, atmospheric (including solar-terrestrial), and ocean sciences, including the relevant biological and social sciences and research in the polar regions. The basic research program is focused on ground-based studies on regional and global scales; large-scale field programs; interpretation and use of remotely sensed data and geographic information systems; theoretical and laboratory research; research facilities support; and the development of the numerical models, information and communication systems, and data bases.

United States Department of Agriculture

USDA conducts research to assess the effects of global change on the agricultural food and fiber production systems and on forests and forest ecosystems of the U.S. and world wide; including, but not limited to, basic research on the biological response mechanisms to increasing greenhouse gases, improvement of plant and animal germplasm to respond to global change, and development and implementation of plans for terrestrial mitigation systems to ameliorate the observed increases of greenhouse gases, including crops and forests. An additional responsibility shall include research on applications of agricultural climatology to improve management decisions and conservation of resources, while maintaining quality and quantity of crop yields.

APPENDIX A: AGENCY ROLES

Smithsonian Institution

Smithsonian's research concentrates on long-term documentation of ecosystem response to environmental change. SI efforts involve enhancements to ongoing research efforts in tropical forest ecosystem dynamics, characterization and quantification of biological diversity, terrestrial and marine ecosystem response to global climate, atmosphere-ecosystem response to global climate, atmosphere-ecosystem exchange, past climate change and ecosystem response, human dimensions of global change and quantitative documentation of global volcanism and other natural components of global change.

Mr. SCHEUER. Okay. Dr. David Reichle, we're happy to have you here, and you're the last witness of the day, and you've shown great patience and tolerance, so please take your five or six minutes and give us your views, and then I'm sure we'll have some questions for the two of you.

STATEMENT OF DAVID E. REICHLE, ASSOCIATE DIRECTOR FOR ENVIRONMENTAL, LIFE, AND SOCIAL SCIENCES, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN

Dr. REICHLE. Thank you, Mr. Chairman. It's my pleasure to be able to accept your invitation and to be with you this afternoon to talk about the environmental research programs in the Department of Energy.

I think we're all very well aware and are becoming increasingly aware of the fragility of our environmental system on this planet and how important it is for us to understand how that system operates if we're going to be caring stewards of our earth.

The fundamental unit of study in the environment is the ecosystem, which integrates the chemical and physical environment with the biological environment and looks at the interactions between these components and their feedbacks on how the system performs in a dynamic function. This system then integrates the atmosphere with the hydrosphere, the geosphere, and the biosphere.

Since the very earliest stages of the Department of Energy's history—its predecessor, the Atomic Energy Commission—this agency was a leader in the area of ecosystem research. In fact, it was the first Federal agency that began funding of ecosystem research. It virtually pioneered the area of systems ecology, and this is the applications of computer modeling techniques and high-performance computing to look at the behavior of environmental systems. DOE has tended to concentrate on specific areas of ecological research which relate to the needs of the mission of the Department of Energy, and particularly it has focused on the transport of materials in the environment—and you can see the obvious connection with the movement and dispersal of pollutants in the environment—and it also has looked at the response of ecosystems to stress, again, the concern for the effects of energy byproducts from energy fuel cycles on the environment.

In this sense, I think the environmental research programs in the Department of Energy are distinct, maybe unique in some aspects, and they're also complimentary to those other Federal agencies, such as the National Science Foundation and the EPA. I think the distinctiveness is the emphasis on long-term ecological research directed at looking at the mechanisms of how ecosystems function and the fact that this work is focused to provide basic science results that support the environmental needs and the requirements of the Department.

Within the Department of Energy system, the National Laboratories provide a very constructive and supportive role to achieving this mission. They provide a large, stable multi-disciplinary work force that allows teams of scientists to be coupled together to attack what are very complex environmental problems. The staff at the National Laboratories understand the technologies and the

technologists within the Department of Energy and are able to bring to bear the science to relate to the technological issues, and personally I feel that the National Laboratories have played a very positive role in serving as an interface between the academic scientist who doesn't understand the technology and the technologists that don't understand what scientific issues need to be brought to bear on the problems they face.

So it's not unusual to have seen, as a result of this history, the Department of Energy playing a key role in ecosystem research, closely coordinated, by the way, with the National Science Foundation. In fact, in the 1970s, during the International Biological Program, these two agencies jointly cost-shared in getting new projects started. The Oak Ridge National Laboratory, which I represent, was one of the major coordinating sites for work on eastern forests, and we're still very proud that the results of this program have been a line item-funded program within the National Science Foundation, which is now their Ecosystem Studies Program.

The Watershed Program within the Department of Energy, which has been a long term project—and Dr. Galas, I believe, gave Anne Polansky a copy of one of the synthesis volumes from that study—20 years of long term biogeochemical studies on the landscape. This work and others similar to it were of instrumental value in the Department of Energy's contribution to the National Acid Precipitation Assessment Program, and much of this historic data was extremely useful in that regard.

Dr. Corell has spoken of the contributions of DOE and how it interfaces with the Committee on Earth and Environmental Sciences. The Department's contributions to those areas comes from its very early involvement in the metabolism of ecosystems, how they process materials and respond to stress, and I can remember the early days when people said, "Why are you worrying about carbon in ecosystems? Why not radionuclides, which are of concern to the Department of Energy?" And I think that's a perfect example of how long term basic research contributes to now understanding the carbon balance of the biosphere and its relationship with the atmosphere.

There is one danger, though, I see as we focus our efforts on specific initiatives in a fiscally constrained environment, and that simply is we tend to rob the core basic science programs in fiscally stable environments to support the—

Mr. SCHEUER. What is a fiscally stable environment?

Dr. REICHLER. Less than cost of living increases.

In the support of new initiatives, we're really eating our seed corn in the demise in many areas of some strong, historically valuable core scientific programs.

I might interject at this point something I feel very strongly about. I think we simply need to do a much better job in this country on developing our capabilities in environmental risk analysis. We've talked a good bit today of basic science as it relates to applied technological problems. We need to do this for several reasons. We need risk analysis to be able to set our research priorities; I think we need it to fulfill a fundamental trust to the public, to be able to communicate the real and relative risks of environmental

problems to them; and we simply need it for the economy of funding our research activities.

I come from inside the Department of Energy's family, being from a National Laboratory, and perhaps can speak to more specific questions you might have on quality control, their planning process, and how they do peer review. As I perceive it, they are deeply involved now in fleshing out at the department and office level the scientific programs to match up with the Department's National Energy Strategy. I think you all are well aware that the National Energy Strategy highlights the fact that environment and economics will be key determinants in deciding this country's energy futures and energy technology options. So I would encourage this committee to ensure that the environmental programs are supported commensurate with their importance as recognized within the Department's long-range planning.

I have prepared a written statement. I'm available and at your disposal to answer any questions that you may have. Thank you.

[The prepared statement of Dr. Reichle follows:]

Testimony of

DAVID E. REICHLE

Associate Director for Environmental, Life, and Social Sciences
OAK RIDGE NATIONAL LABORATORY

ON THE FY 1992 DOE BUDGET REQUEST FOR THE
BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

before the
SUBCOMMITTEE ON ENVIRONMENT
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

March 21, 1991

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
managed by
Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy
under contract DE-AC05-84OR21400

"The submitted manuscript has been authored by a contractor of the U.S. Government under contract No. DE-AC05-84OR21400. Accordingly, the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes."

TESTIMONY OF
DAVID E. REICHLE
ASSOCIATE DIRECTOR FOR
ENVIRONMENTAL, LIFE, AND SOCIAL SCIENCES
OAK RIDGE NATIONAL LABORATORY

BEFORE THE
SUBCOMMITTEE ON ENVIRONMENT
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

March 21, 1991

My name is David E. Reichle. I am Associate Director for Environmental, Life, and Social Sciences at the Oak Ridge National Laboratory (ORNL). I am here today to comment on the U.S. Department of Energy (DOE) basic research program in the environmental sciences. ORNL has been a leader in environmental research in support of DOE's mission and the national interest for more than 35 years, and I have great conviction that the Department's programs have much to offer the nation and the world community both today and in the future. We endorse DOE's environmental research program, but feel that the budget in FY 1992 should be increased to better address the key environmental priorities and to resurrect the core basic programs.

It is appropriate that policymakers and DOE carefully examine our roles and priorities in all areas of environmental sciences research. There is a growing recognition of the environmental fragility of the planet as well as an awareness of the potential for DOE's diverse scientific capabilities to impact on these environmental concerns. To do so effectively requires careful planning and evaluation of research priorities.

The fundamental object of study in environmental sciences is the *ecosystem*, a complex interacting system of biotic (microbes, plants, and animals) and abiotic (soil, water, and atmosphere) components. The ecosystem is one of the most complex objects ever

subjected to rigorous scientific investigation. DOE has been historically the lead agency in supporting environmental research focused on the ecosystem and remains today an important federal sponsor of such research. Given the difficulty of the problem and the limited funding resources, it is not surprising that we do not yet fully understand ecosystem dynamics and have limited ability to predict responses to human activities. This is why greater emphasis on environmental research is important.

Over millions of years, the process of evolution has shaped the ecosystem into a stable configuration. Human social and economic systems cause large rapid changes. The history of the earth, preserved in the fossil record, indicates that large rapid changes can produce devastating results. Because we cannot predict ecosystem response, American society has become suspicious of all large-scale development projects and their potential ecological impacts. Thus, our lack of a scientific understanding of ecosystems rapidly becomes an impediment to economic development. We "protect" the environment because we do not know how to safely utilize it. A predictive understanding of ecosystems requires an integrated team approach involving computer scientists, biologists, chemists, hydrologists, and atmospheric scientists. It requires long-term measurements and field experiments unprecedented in size and complexity. It requires a scientific effort in which universities, federal agencies, and national laboratories will play key roles. Ultimately, an understanding of ecosystem dynamics in the context of a global earth system will require a more substantial national effort than currently exists.

The consequences of proceeding without a predictive understanding of ecosystems are retarded economic activity in the near term and potential disaster in the long term. The potential benefits to be derived from understanding ecosystems are enormous. Consider, for example, the economic advantage to the nation of understanding the real environmental costs of energy fuel cycles. Consider the potential for developing energy technologies, designing industrial processes, and planning the use of renewable resources--all with known and stable ecosystem responses!

BASIC SCIENCE NEEDS AND APPLICATIONS

The following are several examples of priority research and development (R&D) areas identified by the Biological and Environmental Research (BER) Program in its strategic planning that describe DOE's basic environmental research needs and how they relate to the Department's mission. The Ecological Society of America will soon publish further support for these research areas (Lubchenco et al., in press).

Ecosystem Research

Ecosystem research addresses the basic mechanisms by which the biosphere interacts with its physical environment, the geosphere, the hydrosphere, and the atmosphere. In ecosystem theory these reciprocal interactions are classified as feedbacks. With negative feedbacks, the interactions between organisms and environment are stabilizing. However, positive feedbacks are destabilizing and may lead to runaway environmental "chain reactions." Many of man's impacts on the environment fall into the class of positive feedbacks, cases in which a bad situation continues to get worse. Examples of this include desertification, forest destruction and accompanying soil erosion, and, possibly, the "greenhouse effect."

Ecosystem research investigates these feedbacks between living organisms and their environment. One of the most critical ecosystem feedbacks is the response of organisms to environmental stress and the effect of this response on the environment. The economy of ecosystem research is that experiments on individual organisms can lead to predictions about the responses of entire ecosystems. We must support major experimental manipulations to understand how ecosystems function under conditions of temperature, precipitation, CO₂, and pollutants such as ozone that are beyond the ranges which they experience today. Success of this endeavor will require a multidisciplinary effort with strong interactions between the disciplines of biology, mathematics, chemistry, and high-performance computing. The most powerful analytical tools and computer resources must be made accessible to ecosystem scientists in order to collect the data and to refine

the computational methods needed to extrapolate from the measured responses of organisms to the predicted responses of the biosphere.

DOE's past research in ecosystem science, environmental chemistry, and basic plant physiology has laid much of the groundwork for our current understanding of how ecosystems respond to environmental stress and disturbance. The development of new mathematical methods and computer models for extrapolating from the behavior of organisms to the response of ecosystems should be supported by expanding DOE's Theoretical Ecology Program, an action which should be closely coordinated with increased efforts in the basic research on ecosystem feedback mechanisms, an area in which this DOE program has made so many important contributions in the past through its 20-year investment in long-term ecological studies such as the ORNL Walker Branch Watershed Project. The validation of powerful new computer models for predicting the responses of ecosystems to stress with watershed-scale experiments is the DOE research program that will help us solve the environmental problems of hazardous waste management and global change.

Global-Scale Interactions of the Biosphere with Physical Systems

As a result of the enactment of the National Climate Program Act of 1978, DOE began a lead role as coordinating agency for research on atmospheric CO₂. This recognition by DOE of the national importance of atmospheric CO₂ to future national energy strategies is an example of an area in which the agency has taken a positive lead in environmental research. DOE now plays an important role on the interagency Committee on Earth and Environmental Sciences, which coordinates the federal R&D effort on global climate change.

The societal concerns that relate to an increase of CO₂ in the atmosphere center on projections of the phenomenon into future decades and on understanding potential consequences of climate change on the earth system and the biosphere. The consequences of emissions of CO₂ are tied inseparably to the global biogeochemical cycle of carbon.

Significant effort must be put forth to continue to develop the fundamental base of understanding of carbon cycling at the global scale in order to ensure that atmosphere-biosphere interactions are adequately characterized. We cannot ignore these concerns if we are to develop models suitable for future projections.

DOE has extensive plans in place and is initiating research to quantify the important radiative fluxes at the earth's surface and in the atmosphere that control climate so that climate models can be improved (*Atmospheric Radiation Measurement Program Plan*) and to upgrade computing technology and improve the physics and resolution of climate models to take advantage of the newly enhanced computing capabilities (*Building an Advanced Climate Model: Program Plan for the CHAMMP Climate Modelling Program*). Further research will still be needed in two related areas that represent important climate system feedbacks, requiring enhancement of and coordination with existing BER research areas:

- (1) the role of vegetation and other landform characteristics in controlling radiative and energy fluxes between the earth's surface and the atmosphere, and
- (2) the long-term climate effects on the distribution of ecosystems and their climate feedback through control of energy fluxes.

The role of the biosphere in both the global carbon cycle and in the carbon cycle's contribution to the earth's climate system and our fundamental concern for the effects of climate change on biological resources are important research areas needing increased support. Present DOE programs on climate change and resource analysis examine direct effects of climate-change scenarios on biological responses of plant and water resources. Feedback and control mechanisms and combined interactions of facets of climate change (precipitation, temperature, gases, and radiation) are beginning to be addressed as DOE-funded research becomes linked with that of the U.S. Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and others. The scientific challenges of linking small-scale biological processes and feedbacks with large-scale general circulation model (GCM) inputs are critical to understanding how climate changes will affect natural resources. The future calls for greater interdisciplinary

research linking models of several disciplines at several scales. Such work should help to set priorities for basic ecosystem research from an earth systems perspective. The linked models must be tested. Validation sites for at least three scales (site, landscape, and GCM grid equivalent) should provide the basis of research. The biosphere reserves, the National Science Foundation's Long-Term Ecological Reserve system, and DOE's Research Parks could serve in this process.

Environmental Restoration

DOE is presently involved in a facility cleanup effort that is estimated to exceed \$200 billion over several decades: some 1700 sites at about 17 facilities throughout the country are involved. Many phases of this effort can be achieved in a short time frame by using existing technology; such an approach is now under way and is described in the *Environmental Restoration Five-Year Plan*. The immensity of this issue has recently been recognized by the Office of Technology Assessment (OTA) report, *Complex Cleanup*, which raises certain issues with regard to DOE's capability in undertaking a successful restoration effort. The complexity of the cleanup effort with regard to site characterization, contaminant transport predictions, sampling, remediation, and health and environmental effects is immense and will require considerable new basic research that addresses the mid- to long-term needs, rather than just those immediate needs that are covered by the Five-Year plan.

Fortunately, there are existing activities that provide a stable foundation for this longer-range research need. The Subsurface Science Program has been under way for several years and represents fundamental studies related to the movement and behavior of organic and inorganic contaminants (including organic-radionuclide complexes) in the subsurface environments characteristic of DOE sites, as well as studies of microbiological degradation of contaminants; this program is funded at approximately \$12 million per year and represents the only basic research effort directed at this need. In addition, DOE has just released a plan, *Basic Research for Environmental Restoration*, designed to serve as the

framework for the longer-term basic research complementary to the activities of the Five-Year Plan and to cover numerous scientific issues not incorporated into the Subsurface Science Program.

It is clear that significant effort must be put forth immediately to develop the fundamental base of knowledge that will be necessary to help ensure that an acceptable cleanup is achieved and that damaged ecosystems are restored. This will entail the undertaking of specific basic research in support of the restoration effort, as most basic research requires at least a 3- to 10-year time frame for translation into the user community. This is especially true for DOE, because of the extreme complexity and magnitude of the historical disposal problems. Key research areas include, for instance, geochemical transport and transformation processes; multiphase fluid flow studies; advanced sampling, instrumentation development, site characterization, and monitoring methods; and development of finely tuned microbiological remediation methods. In addition, these topics of environmental research provide for unique and enhanced educational opportunities.

The Subsurface Science Program presents an excellent opportunity for performing good science that is highly relevant to pressing environmental problems. The *Basic Research for Environmental Restoration* plan represents the only truly multidisciplinary plan in existence that is specifically aimed at the restoration issue. The present budget does not permit this research to be implemented in a fully adequate manner.

Environmental Biotechnology

Public awareness of environmental concerns associated with the development of new energy technologies, their associated fuel cycles, and environmental restoration has necessitated research on the effects of pollutants on ecological systems and on strategies used to reduce contaminant dispersal in the receiving environment. As noted above, DOE's past operations also necessitate an aggressive program of developing more cost-effective methods for stabilizing and degrading historically released contaminants into forms

that are not biologically available or hazardous. Molecular tools developed for environmental biotechnology are focused on providing solutions to these technical challenges.

Currently, efforts are being conducted for ad hoc or site-specific projects, solving today's problems with today's technologies and demonstrating that the cleanup is effective. For example, molecular biological techniques are being used to identify the genetic loci in microbial systems that enable biodegradation of trichloroethylene (the most common DOE contaminant), thus allowing us to monitor and maximize degradation. Toxicological systems are being used to identify and set priorities for contaminants requiring removal or treatment. Molecular markers (such as DNA adducts) have been coupled with more conventional biological monitoring techniques to demonstrate the success of environmental restoration, and such approaches developed at ORNL are acceptable to the Tennessee Department of Health and Environment and Region IV of EPA.

A basic research program in environmental biotechnology that integrates the science of molecular biology with the constraints of environmental processes while focusing on DOE's concerns is necessary. Unique opportunities exist at major DOE sites to address critical problems of mixed waste remediation by using advanced biological techniques and to test the widespread implementation of these technologies by using the network of DOE's National Environmental Research Parks. Opportunities for educational training and technology transfer abound. For example, new research identifying biomarker systems in plants and animals is necessary to develop early-warning indicators of stress in ecological systems at a time when long-term damage to the environment can still be avoided. The development of microbial markers and gene probes for the detoxification of organic and trace metal contaminants at waste sites is required. Such multidisciplinary activities, involving scientists at the national laboratories, at universities, and in the private sector, have an exceptional opportunity to capitalize on the DOE sites' interface between technology and the environment for cost-effective, innovative R&D that probably could not be conducted in any other setting. Funding needs to be provided to enable scientists

currently working on site-specific projects to initiate basic research efforts that allow for development of new techniques in environmental biotechnology.

Managing Environmental R&D

DOE enjoys the unique characteristic of maintaining a truly multidisciplinary research environment through its core of national laboratories and their well-established interconnections with the university community and the private sector. The uniqueness of DOE can be exemplified by considering its ability to focus on the basic sciences associated with sound energy technology development, while at the same time addressing the applied needs and emphasizing technology transfer by the involvement of industry. The importance of basic science in DOE cannot be overemphasized. It is essential that a basic research foundation be maintained to provide the information necessary to address the applied problems associated with energy technology development and its potential environmental effects. There are several good examples of how support for basic environmental research has allowed DOE to respond quickly and efficiently to meet national needs.

For example, in the early 1970s, basic research in support of forest ecology and plant nutrition provided the foundation for addressing the issues of developing biomass feedstocks as part of the search for viable biofuels. DOE research in physiological ecology and biogeochemistry provided the basis for interpreting the effects of acid rain, SO_2 , and NO_x in the National Acid Precipitation Assessment Program (NAPAP). Similarly, DOE's highly regarded basic research activities on the role of the terrestrial biosphere in the global carbon cycle allowed development of the DOE Global CO_2 Research Program. Lastly, basic research conducted in the 1950s, 1960s, and 1970s on the transport of energy by products in the subsurface, aquatic, and terrestrial ecosystems has provided a unique ability for DOE to address the environmental restoration issues faced today. Unfortunately, in each of these four examples, the funding for basic research has been eroded. Flattened budgets have required focus on immediate needs, at the cost of maintaining a firm scientific foundation as a resource for attacking the next suite of

technical challenges. Maintaining the core scientific capability to solve the problems of tomorrow is one issue that requires significant attention in the DOE research planning process.

To ensure excellence in its R&D programs, DOE and its national laboratory system use an extensive system of planning, oversight, and advisory committees. The Secretary of Energy achieves scientific oversight of the Office of Energy Research (OER) by the Secretary's Energy Advisory Board (SEAB). Biological and Environmental Research in the Office of Health and Environmental Research (OHER) is reviewed by the Health and Environmental Research Advisory Committee (HERAC), one of four OER advisory committees. Each of these committees consists of bodies of experts, substantially outside of the department, with the broad experience and perspective to evaluate the appropriateness of the basic R&D role in support of the DOE mission. Each DOE national laboratory produces an annually updated 5-year institutional plan, which results from a joint planning and site review by OER and OHER management. Each major BER scientific program is regularly peer reviewed in the field, budget submissions and work plans for ongoing projects are evaluated annually, and all new scientific initiatives are externally peer reviewed and reviewed by the internal OHER Research Committee. In addition, numerous workshops, scientific symposia, and site visits by BER program directors ensure the timely progress and communication of research findings. The national laboratories also utilize multiple levels of expert, external reviews at the laboratory, research division, and lower organizational levels to ensure the quality and relevancy of ongoing research and to facilitate both the transfer of research results and R&D program planning.

Periodic, updated strategic planning is a regular mechanism utilized by BER in establishing its R&D emphasis and priorities. Tactical implementation and operational instructions are routinely provided in written guidance to the field, in quarterly BER Program Director's meetings between BER managers, and by representatives from the national laboratories. The issuance of the DOE "National Energy Strategy" and the recent

schedule of internal program planning is evidence that this problem is recognized. Unfortunately, the budget process has recently become so complex and protracted that firm financial guidance commonly reaches the field up to 5 months into the fiscal year, and the impact of Congressional line items on the BER budget has virtually negated the value of much program planning. This seriously disrupts many R&D initiatives and is beginning to destroy the core basic science capability of the BER program.

Who are the principal beneficiaries of DOE's basic research, and how do we judge its usefulness and value? DOE's policy and planning; its environment, safety, and health program; the environmental restoration and waste management activities; and the energy technology organizations are the immediate beneficiaries of the basic research products, although ultimately the nation as a whole profits from this new knowledge. Basic research provides the foundation for sound environmental legislation (e.g., DOE-sponsored research and national laboratory scientists have been important to the Clean Air Act Reauthorization of 1990 and the current Clean Water Act reauthorization activity). DOE has been a leader among federal agencies in technology transfer to the private sector, and recent establishment of Cooperative Research and Development Agreements (CRADAs) issues has enhanced R&D collaboration with industry. The Electric Power Research Institute, the Gas Research Institute, and the American Petroleum Institute sponsor energy and environment research at DOE national laboratories. DOE has been a prominent and responsible partner in interagency environmental initiatives such as NAPAP and the Committee on Earth and Environmental Systems (CEES). DOE plans and coordinates many environmental research initiatives with EPA, the National Science Foundation (NSF), and the National Oceanic and Atmospheric Administration (NOAA). The Nuclear Regulatory Commission (NRC) and the Federal Energy Regulatory Commission (FERC) are customers of DOE's national laboratories, utilizing their unique resources to address critical national energy and environmental issues. And finally, there are the training and educational opportunities offered to the next generation of U.S. scientists through active research participation at DOE national laboratories.

Because of its very nature, it is difficult, and often unwise, to set priorities for long-term basic R&D in a detailed fashion other than to identify major emphasis and directions. However, there are some new integrative techniques that are applicable. For instance, risk assessment methodology provides an objective approach for establishing research priorities that reflect the relative importance of evaluating alternative schemes for risk reduction, and for balancing competing kinds of risks. The importance of greater national attention to ecological risks was recently highlighted by the EPA Science Advisory Board's Relative Risk Reduction Strategy Committee. Much of the pioneering R&D on this topic has been done at the DOE national laboratories. Because energy production and use contribute to virtually every environmental problem of current national concern, DOE should play a major role in development of reliable approaches to quantifying ecological risks.

Research on resource economics, statistics, expert systems, risk communication, and social acceptance--in addition to DOE's current ecological research--is also needed. The requirement to express different kinds of risks in comparable terms (e.g., global climate change and sulfur deposition to environmental contamination from hazardous wastes) means that additional research is needed on methods for extrapolating across scales (space and time) and levels of biological organization. Some work of this nature is already being performed at ORNL. In fact, much of the ecological research traditionally supported by DOE (e.g., systems ecology, biomarker studies, and environmental transport modeling) could contribute to improved ecological risks assessments. Broader applications of risk assessment techniques within DOE's environmental restoration program and technology development programs would significantly improve the value of environmental research in the same way that the comparisons of watershed chemistry models for NAPAP have enhanced the value of DOE's research on model uncertainty analysis. The National Academy of Sciences has already begun to lay out a systematic framework for assessing ecological risks, applicable to the full range of problems of interest to DOE and the nation. The next step is to compare the information required for comparative risk assessments

with the research currently being performed by DOE and other agencies such as EPA. This exercise will permit identification of (1) critical research that is not currently being performed and (2) opportunities for practical application of DOE's existing ecological research.

We need to be able to depend on the DOE National Energy Strategy as a basis for long-range research planning. The National Energy Strategy emphasizes the cultural determinants that will affect future energy policy and technology. Environment and economics are identified as critical factors that will influence, if not dominate, future U.S. energy policy and technology options. It is important, therefore, that future budgets for basic environmental research and the National Energy Strategy objectives coincide.

SUMMARY

DOE's environmental program is a long-term basic research activity devoted to understanding the fundamental environmental processes underlying the function of diverse ecosystems. The terrestrial research program emphasizes theoretical ecology, subsurface sciences, ecological responses to stress, the dynamics of watershed ecosystems, and pattern and process at the landscape scale. These program elements are specifically designed to provide information supporting DOE's mission needs in the areas of environmental protection and site remediation resulting from historic activities at DOE sites and to support the implementation and planning of new energy technologies.

DOE is uniquely equipped to focus on the major national problem of hazardous waste management, using its R&D strengths in environmental systems analysis, hydrogeology, geochemistry, and environmental biotechnology to develop new, innovative, and cost-effective remediation techniques.

Since energy production is both a causative factor and solution to many of the issues related to global environmental change, DOE's historic leadership in this field is closely coordinated with other federal agencies. DOE's specific contributions center on its unique capabilities for large-scale, interdisciplinary field research and high-performance computing

to attack the issues of climate dynamics, climate change, the global carbon cycle, ecological responses to climate change, and the role of the biosphere in regulating global climate.

DOE has tremendous potential to provide the necessary basic research and the technology transfer to the applied problems in these environmental areas of critical national concern. The BER basic science programs have provided focused, long-term continuity in environmental and ecological research. Historic budget levels have been inadequate to fully capitalize upon this potential, and I encourage the Committee to support the BER program.

References

- DOE. 1989. *Environmental Restoration Five-Year Plan*. DOE/S-0078P. U.S. DOE, Office of Environmental Restoration and Waste Management.
- DOE. 1990. *Atmospheric Radiation Measurement Program Plan*. DOE/ER-0441.
- DOE. 1990. *Basic Research for Environmental Restoration*. DOE/ER-0482T. U.S. DOE, Office of Energy Research. 156 pp.
- DOE. 1990. *Building an Advanced Climate Model: Program Plan for the CHAMMP Climate Modelling Program*. DOE/ER-0479T.
- DOE. 1990. *Subsurface Science Program: Program Overview and Research Abstracts*. DOE/ER-0432. U.S. DOE, Office of Health and Environmental Research. 150 pp.
- DOE. 1990. *Theoretical Ecology Program*. DOE/ER-0475P. 28 pp.
- EPA. 1990. *The Report of the Ecology and Welfare Subcommittee, Relative Risk Reduction Project, Reducing Risk*. EPA SAB-EC-90-021A (Appendix A). 77 pp.
- Lubchenco, Jane, et al. (in press). "The Sustainable Biosphere Initiative: An Ecological Research Agenda." *Ecology*, Vol. 72(2).
- OTA. 1991. *Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production*. OTA, 052-003-01222-7.

Mr. SCHEUER. Very good.
Congresswoman Morella?

Mrs. MORELLA. Thank you.

I'm very interested in what you're doing, and I have your testimony before me, and I'm sorry that I was out with constituents.

Is there anyone here from the Washington Post now who's going to write about that?

[Laughter.]

Mrs. MORELLA. As they did when they said we had 57 committees all meeting at the same time yesterday, and indeed we did, and yet we did spend a lot of time on this subcommittee.

Recently, Dr. Corell, there was a conference that was held in this area. Was it European Community? And it was on global change, right?

Dr. CORELL. I suspect what you're referring to is the framework convention meeting that was held out in Chantilly.

Mrs. MORELLA. Yes.

Dr. CORELL. Yes. The U.S.—in fact, the President indicated a willingness of the U.S. to host the first framework convention, which we did, which will start a process that most are hoping will conclude with some sort of signatures in Brazil in 1992.

Mrs. MORELLA. Right. Give us your assessment of what happened there.

Dr. CORELL. Well, I personally was not at the meeting, except for one small period of time, but the CEES and the agencies have ample opportunity to provide counsel to and work with our official delegation, from a scientific perspective. In fact, Gary Evans, who is sitting here from the Department of Agriculture, is one of the scientists who is on the U.S. delegation, along with several others, all of whom are a part of the CEES process.

I think you can say that this meeting set the stage. As you well know, in international meetings that are intended to lead to protocols or some sort of formal arrangements between countries, there are many organizational details that have to be worked out, and those were started well on the way. It has a long way to go, but I think all of us are hopeful that that process will play out well.

Mrs. MORELLA. Yes, I think the idea is a very good one, and I hope the process will play out well, too. I had talked to some of the participants from some of the other countries while it was going on, and it was evidently very slow in moving.

In your opinion, are there any lessons to be learned from the CEES' review of projects in the Global Change Research Program which could serve as the foundation for improving the review process in the BER Program, as Dr. Reba—I'm sorry I missed him—as he had stated?

Dr. CORELL. We have worked, as we do with all the agencies, with the Department of Energy and with Dr. Patrinos and his colleagues in reviewing all of the programs that are coming in from the Department of Energy. As I outlined, we apply that full range of peer review process. From our perspective, it's a sort of multi-level review from reviewing your basic assumptions about what you're doing, what your goals and objectives are, and having those peer reviewed. It seems, from our perspective, that that's worked well right down to the individual projects.

The interactions we've had over the ARM and CHAMMP Program have been, in my judgment, extraordinarily well done. The Department has worked very closely with us. Just the week before last, the CHAMMP Program, along with the other modeling programs, were a part of a three-day review with the JASONs out in La Jolla, California. It's just one step in the long process.

We think that this multi-level approach is extraordinarily important to a comprehensive program like the Global Change Program. I don't know enough about the internal workings of the BER effort at DOE, but I suspect from what I hear today and also in talking with DOE officials, they're applying many of the same principles.

Mrs. MORELLA. It sounds like your interaction with DOE really has been highly successful.

Maybe I should ask Dr. Reichle, do you think that the peer review at DOE should be stronger?

Dr. REICHLER. I have not experienced problems with—

Mrs. MORELLA. Evidently, Dr. Reba had talked about the fact that it was at the expense of the nuclear medicine.

Dr. REICHLER. My experience has been we live in a world of constant peer review, and from the perspective of a National Laboratory, all new initiatives, new proposals, that we submit to the Office of Health and Environmental Research, which administers the Biological and Environmental Research Program, all new proposals are peer reviewed. Our existing programs have work statements which are reviewed annually, budgets are reviewed annually, and programmatic efforts—this is large integrated projects—are generally reviewed on-site technically by technical outside peer reviews within the three- to five-year time frame. We go through annual planning with the Department of Energy at the laboratory level on charting the courses in science that we'd like to go, and we're reviewed annually on that with site reviews by the Office of Energy Research.

So I have not been concerned personally, other than we spend an awful lot of our time going through peer reviews. An extremely extensive part of our time. It's a rigorous process, it's not unhealthy, but it is time-consuming, as well.

Mrs. MORELLA. How, then, can you justify what Dr. Reba had said with regard to the process not working and the inequities in the—

Dr. REICHLER. I don't think what I've said was at all inconsistent with what his concern was. I think peer review of Congressional items that were going outside of the—

Mrs. MORELLA. Again, the appropriations, the Congressional designations versus the peer review in—

Dr. REICHLER. Yes. But I think his statements were very supportive as were Dr. Corell's—

Mrs. MORELLA. And you would then agree with that part of it.

Dr. REICHLER.—of the peer review process.

Mrs. MORELLA. Thank you. Fine. Thank you.

Anything else that either of you want to add that I didn't ask?

Dr. REICHLER. No, that's fine.

Mrs. MORELLA. Thank you very much, Mr. Chairman.

Mr. SCHEUER. Thank you, Congressman Morella.

I'm going to ask a couple of questions to both of you, and we'll conduct our hearing very informally.

Since the Working Group on Global Change was established several years ago and began looking at DOE's global change research activities, in that period of time, how do you believe the quality of research conducted by DOE under the Carbon Dioxide Research Program has changed? Has it changed, for the better, for the worse? What has been the impact of the CEES leaning on the DOE research program instead of holding it by the hand and trying to bring them along?

Dr. CORELL. I think that's addressed to me. In this three-year period, Mr. Chairman, the CEES has tried to evolve a sort of different way of doing business. In the early days, I think there were expectations that this committee might function like some of the other committees have in working across agency lines—that it would be a forum for conversation, coordination—but that changed early on.

As I indicated in my written testimony, there's a contract-like relationship that OMB annually puts forth for the workings of the committee, and it is called the Terms of Reference. It assigns responsibilities to the three partners in the building of a budget: to the committees, to the agencies, and to the Executive Offices of the President, namely OMB and OSTP. It puts some teeth in our recommendations. We are still a recommending body, we don't run programs, programs are actually implemented through the agencies.

Well, with the establishment of that, there evolved a very different way of doing business. The outline I gave you of the merit review process was the evolution to get us to the time we are now. If you look at our first program, in all candor, it was basically an ensemble of the programs that were put forth by the agencies. That was three years ago. We did not have the machinery in place. We were not party to the review process.

Well, moving from that place, virtually all of the agencies experienced some pain, if you will, of adapting to a committee that has this kind of responsibility and an expectation that it will deliver quality in the end. NSF and DOE and all the others together experienced that new way of doing business.

I think the experiences with the ARM and the CHAMMP Programs are excellent examples, because the early participation with the committee two and a half years ago with those programs is different from the way we're doing business today. We in the committee grew and changed, as did DOE and other agencies, as we began to look at these programs.

As I tried to indicate, I think the relationship now is one where we're all in sync. We have expectations for peer review of the highest level. In fact, DOE has been a major player in assisting other agencies to see the role that that kind of peer review process can do for the program. We have better programs, in my judgment, fielded in the 1991 and 1992 budget as a consequence of that process.

We try not to step on, you know, authorities of agencies. That's a tough issue, to try to work across agency lines on one hand and on the other hand recognize that these are agencies that have the re-

sponsibility, that are appropriated the funds, and have to deliver the goods in the end. But we think that balance has come forth.

This JASON meeting 10 days ago was a good example. It was born in concert between several agencies who have modeling programs, CHAMMP being one within DOE. We exposed what we're doing to the JASONS, which is an outside review body established a number of years ago and early on focused largely on DOE programs, but in recent years has taken on a broader perspective. If I can say it, they're the gray beards of our business, people who have extraordinary records of accomplishment, and to be able to lay out what you're doing in flight, while you're doing your program, and have them tear it apart, we benefit from that, and we adjust our programs as a consequence of that input. It's a part of the ongoing process in addition to the peer review of intense character that occurs at the initiation.

As others have indicated, we do this on an annual basis. CEES literally looks at every single project every single year, and we do this with panels that work at the level of scientists and program officers of the Government.

I don't know whether I'm getting at your issue—

Mr. SCHEUER. Dr. Reichle, do you have anything further to add?

Dr. REICHLE. I would support what Dr. Corell has said. I would hesitate to speak to changes in the quality of the science, because I think that has always been high at the Federal agencies we're talking about, including the Department of Energy, but I think the coordination that CEES has provided — and this is unique in the sense that it's, I think, in my experience, the first time that inter-agency coordination in the area of the environmental sciences has really worked.

I think the profit we've had from this has been the efficiency and lack of overlap, the efficiency and the complimentation and the synergism of closely coordinated work between the different agencies.

Personally, I've been pleased to see other agencies compliment our laboratory, a DOE laboratory, on their work. CEES has asked our scientists independently—and you know the National Laboratories like to retain their intellectual autonomy and independence—we've been able to be critical of the Federal program, we've been encouraged to do this by the Department of Energy, they've supported a free and open exchange, and I think the net effect has been nothing but positive. It's a very good model.

Mr. SCHEUER. If it's a good model—and I accept you at your word; I'm very satisfied and pleased at the testimony you've just given me in the last few minutes—if it's a good model, why wouldn't it be a good idea to replicate this kind of CEES peer review to other research programs at the DOE?

Dr. REICHLE. I think this is already occurring, and I will have to defer again to Dr. Corell, who is more intimately involved. Just within the last year, the committee title has been expanded from "Committee on Earth Sciences" to "Committee on Earth and Environmental Sciences," I think to represent the broadening role. There is another Subcommittee on Water Resources, which—

Is that correct?

Dr. CORELL. That's correct. Water quality.

Dr. REICHLER. Water quality under CEES, which the Sub-Surface Science Program within the Department of Energy now coordinates and is working with and through in terms of coordinated activities and joint reviews. So I think I see this process actually occurring.

Dr. CORELL. Let me just expand. The CEES does have several working groups in addition to the Global Change Working Group. There is a Working Group on Mitigation and Adaptation Research Strategies, the chairman of which is Gary Evans, who is sitting to my right here. Their job is to look at that whole area of impacts, mitigation, adaptation with respect to global change issues, and the techniques that have been developed within the CEES family will be applied there, and the Department of Energy is a key player. In fact, the vice chairman of that working group is from DOE.

Water quality is another part of the CEES process. We have a Subcommittee on Atmospheric Research, which tends to worry about shorter term scales of variability in the atmosphere—weather, to be specific. Similar techniques are intended to be applied there and so forth throughout the CEES.

If Dr. Bromley were here, he would indicate to you, as he has said publicly many times, that he fully endorses this approach to coordinating and reviewing and building Federal programs, and it was a cornerstone in his early days as the President's science and technology advisor to restructure the FCCSET process so that this pattern of approach would be applicable in a number of other areas.

Two examples are in the President's budget in 1992 beyond the Global Change Program. One is the high-performance computing and communications initiative, born in the FCCSET process, born with the same sorts of, if I could say, gestalt approach to science planning. It's a multi-agency effort, and DOE is an extremely central player in that particular initiative. Similarly, as you know, the President has indicated a desire to substantially address the science and engineering and mathematics education issue, and the third of these so-called Presidential initiatives under the FCCSET has to do with education and human resources, and they intend the same pattern to apply there. So there are a number of places where a philosophy of interagency coordination is in place.

I'd like to make just one last comment about the word "coordination." When we use that within the CEES framework, we have very specific meaning to that. I've told you some of the arrangements that we have with the OMB. There's a contractual-like relationship about what we do. But if I were to summarize it, we mean more than just getting together and linking our programs together; we mean to build integration across the agencies, we mean to push hard on the issue of quality so that that which is fielded is not only an integrated program, but it's the highest quality we can put forth, and that it is relevant to the agenda of the United States of America.

Mr. SCHEUER. Dr. Corell, give us your assessment of the cost effectiveness of research that's conducted by the National Institute of Global Environmental Change at the University of California. This was one of the Congressionally directed projects. There has been some skepticism—

Dr. CORELL. Mr. Chairman, I am not as familiar with that as I should be, and I will be very pleased to provide for you an answer to that in the written record. I just don't have enough factual information, but I'd be more than happy to do so.

[The information follows:]

Testimony of Joseph B. Knox, Director

National Institute for Global Environmental Change

To the House Appropriations Subcommittee on Energy and Water

April 9, 1991

The legislation of this congressional committee established and provided the resources for the National Institute for Global Environmental Change on September 29, 1989. It is a pleasure to be present today to report on the status of our Institute, selected technical highlights to date, and some plans for future activities. At the outset, we must express our appreciation for the opportunity to contribute to the knowledge base of global climate change, the reduction of key scientific uncertainties inherent in the projections of future climate states and the perturbations attributed to man's activities, and to the development of policy options applicable to preparing for plausible climate change. Our mission is to support the sponsoring agency, DOE, in its challenging tasks within the federal Global Change Research Program. At the same time, we are giving significant emphasis to educational needs spanning the needs of the policy makers to general education to the nurturing of young scientists specially trained for global environmental change research.

With concurrence of the DOE, we have adopted the following balance to our academic research program: research on the scientific aspects of global environmental change (70%), research undergirding the development of policy strategies and options (25%), and educational efforts (5%). Our policy related work seeks the practical application of science in the pursuit of appropriate management of plausible climatic conditions of the 21st century.

From the fall of 1989 until April 1990, our activities focused on the organization of the Institute, the creation of the four Regional Centers and their Directorships at Harvard, Indiana University, Tulane, and the University of California, and the development and review of the proposed research for the first years' funding (FY 90) of \$6 million. The formal proposal for the Institute (with headquarters at University of California, Davis) and the start-up research program was approved by the DOE in April 1990. The formal Cooperative Agreement between the DOE and the University of California, Davis was completed in September 1990. In parallel with this administrative activity, some investigators did commence research activities as early as July 1, while others, depending on the management conservatism of the host institution did not begin until as late as January 1991 in part due to subcontracting arrangements.

Joseph B. Knorr
April 9, 1991

Each Regional Center has adopted research thrusts to promote synergism between related projects, to focus on significant global change features of their geographical region, and to provide integration and applicability of the information obtained. These integrating thrusts add an element of uniqueness to the NIGEC program in comparison to investigator-initiated research grants widely dispersed. In many cases, our regional research themes result in field learning centers important for involvement of young scientists and regional outreach. The research thrusts of each of our Regional Centers of NIGEC are shown below:

Northeastern Regional Center:

- Temperate forests, their role in the global carbon cycle, decomposition processes, and their energy balance.
- Studies of past climates and the development of techniques using C4 plants (e.g. corn and maize) for estimating past climatic states over continents.
- Development of a framework for risk assessment of global climate change.

Midwestern Regional Center:

- Atmospheric trace gases, their trends and spatial variability.
- Water resources, biological productivity, and their relationships to climate (with a regional focus on midwestern wetlands).
- Policy issues related to energy use.

Southern Regional Center:

- Modeling of recent and past global climate changes.
- Atmospheric chemistry of greenhouse gases with focus on methane emissions from rice fields and ocean-bed methane hydrates.
- Ocean biochemistry.

Western Regional Center:

- Atmospheric and oceanographic modeling of global climate change.
- Variations in concentrations of radiatively and chemically important trace (greenhouse) gases in the atmosphere.
- Ecological consequences of global warming for both managed and natural ecosystems.
- Policy related research and education.

Joseph B. Knox
April 9, 1991

Selected technical highlights are discussed in our first semi-annual report to the DOE covering the period of July 1 to December 31, 1991, a copy of which is made available to the committee along with this testimony.

Several characteristics of our first year's research program are worthy of emphasizing:

- The use of research thrusts to promote integration and synergism among investigators within each region of NIGEC.
- The cross-cutting theme of atmospheric chemistry linking the Regional Centers.
- Initial outreach research in the first year wherein at least twenty percent of each Center's funding was to institutions other than the host institution.

In spring of 1991, our four Regional Centers have just completed their request for proposal (RFP) process within their regions utilizing the FY 91 funding to NIGEC of \$9 million; final selection of successful proposals within each region is not yet complete at this date, but we expect to meet the goal of 50% of the funding being allocated outside of the host institutions with the research by the successful awardees beginning this July 1. Our Coordinating Board of the Institute has authorized the NIGEC Director to utilize a portion of the funds allocated to the institute management entity for especially meritorious endeavors of national significance or uniqueness. Two projects were funded from FY 90 resources. The first is the development of a high school level curriculum on global climate change by the Lawrence Hall of Science, with the curriculum materials being available to the school districts across our country in fall of 1991. This will be an effort of highest quality to provide students with up-to-date information on the planetary issues and challenges of global climate change in the next century.

A second project of unique national interest involves funding the proof-of-concept of first generation unmanned aircraft capable of probing the lower and middle stratosphere to heights of 100,000 feet or more for making measurements of chemical constituents, chemical processes, and radiation fluxes. Our funding will result in early test flights in the arctic this June with early data shared with the scientific community. We expect that this unmanned aircraft capability, wherein the aircraft are retrievable and reusable, will lead to early and economical data on global environmental change and its detailed processes far in advance of data from the EOS. The particular aircraft being supported is the PERSEUS A being developed by Aurora Flight Services of Alexandria, Virginia.

The Institute is also planning an international conference on the cycling of methane in the atmosphere, and the development of information regarding its sources and sinks. Methane is known to be one of the most important of the greenhouse gases; but with a relatively short residence time in the atmosphere and with only a 10% excess

Joseph B. Knox
April 9, 1991

of source over sinks, methane is an important target for atmospheric concentration stabilization. It may in fact be feasible to stabilize methane earlier than carbon dioxide through preventing leakage from natural gas transmission systems, altering diets of ruminants, and changing practices of cultivating rice, for example. The scientific basis of these and other options need development beyond the perception that this may well be a most promising avenue of endeavor. Current research in three of our Regional Centers bears on developing information essential for these options. Our NIGEC Methane Conference is scheduled for January 4 to 10, 1992 with Professor F. Sherwood Rowland serving as the Chair.

In looking forward to the 21st century we can with some confidence project that it will be known as the century of the environment. A time when all peoples of the planet must come to deal with the tensions surrounding our finite resources, their most prudent use and stewardship even as global environmental constraints emerge. Global scale cooperation and stewardship of resources and the environment requires the best possible understanding and information.

We at NIGEC wish to thank this committee for the opportunity to contribute to the preparation and the research and development needed to meet this challenge and our planet's inevitable journey towards confrontation with that challenge.

Joseph B. Knox

Mr. SCHEUER. All right. I have another couple of questions, but I'd like to yield to Mrs. Morella.

No questions? All right.

In your opinion, Dr. Reichle, is the establishment of the research agenda for DOE's National Laboratories dominated primarily by laboratory scientists or by DOE management at headquarters?

Dr. REICHLER. The agenda for research, if I could define your use of the word would be the general programmatic directions and objectives, this would be a headquarter responsibility. The Federal agency is responsible for its science planning and its mission program development. The process of this planning, I think, is one of the very great—within the Department of Energy—one of the very great strengths that the Department has with the resource of its National Laboratory system and its university community working with it.

As opposed to some Federal organizations which I've been familiar with in the past, we seldom have the Department of Energy defining specifically how research tasks will be completed at the headquarters level. They define the need and the general objective, and they leave to the creativity and innovation of the scientific staff and their laboratories to define the most creative and appropriate ways to achieve that objective. I think that's a beautiful bit of harmony that seems to work very well and productively.

Mr. SCHEUER. Dr. Reichle, you mentioned to me for risk analysis setting research priorities. In your opinion, is risk analysis an important factor in the decisionmaking process at DOE headquarters for funding research programs? Does it play a really important role?

Dr. REICHLER. Within the R&D?

Mr. SCHEUER. Yes. How significant is it? How productive is it?

Dr. REICHLER. I would like to see it used more than it is now. The Department of Energy and the Office of Health and Environmental Research had initiated some years ago a program in risk analysis, and this was during the Carter Administration, during the Syn-fuels programs. This activity was extremely productive in helping to establish priorities not only of the technologies, but also the priorities of the relevant health and environmental risks associated with each of these technologies. This was technology-driven, so there was some excellent leadership in that area.

In the Environmental Restoration and Remediation Programs in the Department of Energy, with which I'm not as familiar, they currently do use risk methodologies in setting priorities for their waste remediation and cleanup activities.

Then there are variants within each of the scientific programs which you may play with the word "risk," but I know within the Carbon Dioxide Program at DOE, specifically in the Global Carbon Cycle Program, there is a great deal of mathematical analysis of the uncertainties and error analysis of models and evaluation of the appropriateness and goodness of data. Now, while not in the traditional sense of a risk analysis, I think it shares many of the elements.

I think we could do more than we're doing, but we are doing some.

Mr. SCHEUER. Dr. Reichle, give me an example of how research in environmental science has resulted in both cost savings to the DOE and the protection of the environment.

Dr. REICHLER. I think I would use as my example several contributions which quickly come to my mind from the basic science programs dealing with the site restoration cleanup activities at the laboratories. Most of what we read of in the papers about the waste legacy at DOE sites is related to the Defense production sites.

In Oak Ridge, the Oak Ridge National Laboratory is located in fairly close proximity to one of these weapons production laboratories. As the environmental cleanup activities began and as the State environmental agencies and the EPA Region 4 out of Atlanta became the regulatory oversight for this, there were a number of issues which arose. In many cases, it is not cost effective or even practical to implement some of the regulatory standards that now exist for this cleanup activity.

One of the things negotiated with the Region 4 EPA office in Atlanta were to use biological monitoring protocols which came out of the BER basic research programs to demonstrate the absence of any significant ecological risk in all of the watershed surrounding in which the low-level effluents were coming from these weapons production facilities. This was instrumental, because many of these pollutants act synergistically together, and there are no regulatory standards which deal with those. So these facilities are operating safely, environmentally safely, at this time in lieu of applicable standards due to a monitoring program coming out of the basic research programs.

Another example—and I'll try to be very brief; I know the afternoon is progressing—would be the use of naturally selected microbial organisms to be used to degrade organic contaminants in the environment. Our current regulatory constraints—and I think they are appropriate—is that genetically engineered organisms can be used with a great deal of difficulty, as you're aware, right now in terms of a release to the environment. But, using the experience of the ecological programs which have selected for organisms which live in environments which have already preselected for them through evolutionary selection we are able to find organisms which can break down trichloroethylene and PCBs and are being used now in model demonstration projects to break down these organic contaminants in situ, in the ground, much more cost effectively than more typical removal processes would historically have allowed us to do.

So I think those are two good examples, and there are others. In fact, the DOE Environmental Restoration Program has used some of the cost effectiveness criteria for their investment in some of the short term technology demonstration projects. I think it's a good example of where some basic research has been very profitable in the surprising short term.

Mr. SCHEUER. Do you have anything to add, Dr. Corell?

Dr. CORELL. No, sir.

Mr. SCHEUER. Well, you've given us extremely interesting and encouraging testimony. I appreciate it very much. I'd like just to ask you sort of informally and off the record whether the two of you would be willing to work with this subcommittee in developing

legislation to require peer review of Congressionally directed projects.

Dr. CORELL. I'd be more than delighted to, sir.

Dr. REICHLE. I'd be happy to help in any way that I can.

Mr. SCHEUER. Okay. Well, the afternoon is late, and I want to thank you both for your patience and your tolerance and your excellent testimony. We're really grateful to you both.

The hearing is suspended at the call of the Chair.

[Whereupon, at 4:02 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

APPENDIX

ACNP

American
College of
Nuclear
Physicians

1101 Connecticut Avenue, N.W. • Suite 700 • Washington, D.C. 20036

202-429-5120

SNM

The Society
of Nuclear
Medicine

March 25, 1991

Anne Polansky
Professional Staff Member
House Science, Space and Technology Committee
Subcommittee on Natural Resources, Agriculture Research and Environment
H2-388 House Office Building Annex II
Washington, D. C. 20515

Dear Anne,

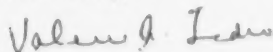
On behalf of Dr. Reba, the American College of Nuclear Physicians (ACNP) and the Society of Nuclear Medicine (SNM), I would like to thank you for the opportunity for ACNP/SNM to participate in the hearing on the fiscal year 1992 budget request for the Department of Energy's (DOE) Biological and Environmental Research Program (BER).

As we have indicated to you, the ACNP/SNM strongly supports the peer review process for all projects funded by the DOE. We regard the bypass of scientific peer review as one of the major impediments to further funding and development of worthy research in nuclear medicine. We commend Rep. Scheuer for his leadership and commitment to an efficient peer review process. The ACNP/SNM will lend their full support to legislation which requires peer review of all research programs and construction projects financed by the DOE.

The ACNP/SNM respectfully request that the enclosed statement be included in the hearing record. I would be most appreciative of a copy of the transcript and all testimony and comments.

Thank you again for the opportunity to present our views on the DOE's peer review process. If I may be of further assistance, please do not hesitate to contact me.

Most sincerely,



Valerie A. Fedio
Assistant Director of Government Relations



American
College of
Nuclear
Physicians

1101 Connecticut Avenue, N.W. • Suite 700 • Washington, D.C. 20036

(202) 337-5121



The Society
of Nuclear
Medicine

STATEMENT OF

THE SOCIETY OF NUCLEAR MEDICINE

and

AMERICAN COLLEGE OF NUCLEAR PHYSICIANS

concerning the

DEPARTMENT OF ENERGY'S FISCAL YEAR 1992 BUDGET

for the

MEDICAL APPLICATIONS PROGRAM

submitted to the

HOUSE OF REPRESENTATIVES

SCIENCE, SPACE AND TECHNOLOGY SUBCOMMITTEE ON

ENERGY, RESEARCH AND DEVELOPMENT

March 19, 1991

The Society of Nuclear Medicine (Society) and the American College of Nuclear Physicians (College) are pleased to offer the following statement regarding the Department of Energy's Fiscal Year (FY) 1992 budget. Together, the Society and the College represent over 14,000 physicians, physicists, chemists, radiopharmacists, technologists and other professionals engaged in nuclear medicine research and clinical practice.

SUMMARY

The Administration's FY 1992 budget proposal seeks \$33,900,000 for the Department of Energy (DOE) Medical Applications Program. Over the past decade, the budget for the DOE Medical Applications Program has been flat or declining with substantial appropriations earmarked for special projects that do not enhance or contribute to the overall nuclear medicine research program. The College and Society recommend a funding level of \$42,135,000 or an annual increase of 6% from FY 1989.

The College and Society appreciate the severe budget constraints that the Congress and your Subcommittee must consider in addressing FY 1992 budget needs. However, previous research activities resulting from the DOE's Medical Applications Program, designed to enhance the applications of both radioactive and stable isotopes, have contributed significantly to the health care delivery system in the United States. In order to continue the progress and momentum achieved in the field of nuclear medicine, it is imperative that funding for research efforts be increased.

The declining financial support of research exacerbates the problem of the lack of national resources (for example, accelerators and reactors) to produce radioisotopes. In fact, in the foreseeable future, radioisotopes may only be available from foreign sources. Of note, there is no domestic supply of a radioisotope critical to nuclear medicine (molybdenum-99) and it is expected that DOE labs will cease to produce accelerator isotopes within the next five years.

Last year Capt. William Briner, (Ret.), Chairman of the Government Relations Committee for the Society, testified before this committee and illustrated these problems. "Of immediate interest is the current limitation on the supply of this critical radioisotope [molybdenum-99]... More than 90 percent of all nuclear medicine diagnostic procedures in the U.S. are performed with this material...More than 10,000,000 nuclear medicine studies are performed in the United States each year and this should not be compromised."

After the permanent shut down of the Cintichem Reactor in Tuxedo, New York, the sole source for MO-99 became the Nordion, Inc. (formerly AECL) Chalk River, Ontario, Canada reactor. In January 1991, this reactor was forced to shut down due to complications. The supply of this critical material was interrupted for days and shortages in the medically important isotopes, iodine-131 and phosphorous-32, still persist. The U.S. has no recourse but to rely on a Canada-based backup reactor until further notice.

The College and the Society are currently working with the DOE to address the need for accelerator produced isotopes. The ACNP and SNM have developed a proposal together with the DOE for a National Biomedical Tracer Facility (NBTF). The NBTF will be a high energy accelerator dedicated to training in the radiologic sciences, biomedical research, and isotope production. This proposal will be submitted to the Congress, the Secretary of DOE and the President of the United States for consideration within the coming weeks.

However, the very critical problem of reactor produced isotopes is a far larger issue that must be addressed at an increased level. It would be uneconomical to dedicate a nuclear reactor for biomedical purposes. Therefore, we urge this Committee and the Congress to address this need.

The College and the Society have three primary goals:

1. Increase and protect the DOE Medical Applications Program.
2. Establish a National Biomedical Tracer Facility for training, education, research, and production purposes.
3. Direct the Hanford Fast Flux Test Facility to become a national production center for molybdenum-99 (Mo-99).

NUCLEAR MEDICINE TODAY

In a typical nuclear medicine procedure, a tracer chemical substance is administered in the form of a radiopharmaceutical. The diagnostic use of a radiopharmaceutical is based upon the ability of the imageable or traceable agent to measure and evaluate organ function or a disease process. Certain radioactive drugs are designed to concentrate only in abnormal tissue such as cancer cells or compromised heart muscle. The transit is recorded by instrumentation which images the distribution of the radioactive preparation in the body. Data derived from the examination may also be processed by computer, producing improved images and quantitative information about organ function. Depending on the degree of specific localization and the physical and biologic behavior of radioactive labels, radiopharmaceuticals can also be used therapeutically for certain conditions.

Diagnostic in vitro examinations encompass certain tests (radioimmunoassay) in which a sample of body fluid is mixed with a radioactive reagent. These tests are used to determine the presence of cancer antigens, the precise concentration of various hormones, vitamins and drugs and to identify pollutants or other toxic materials in the environment. Radioimmunoassay techniques permit early discovery of tumors and metastases before they become clinically evident.

THE ROLE OF NUCLEAR MEDICINE

The Society and the College believe that nuclear medicine procedures enhance the diagnostic process by reducing total health care costs, decreasing the patient's length of stay as well as the patient's suffering by rapidly directing patient treatment. In addition, nuclear medicine procedures often provide more useful information about the patient's problems than other data available from alternative diagnostic modalities, many of which are much more costly. One in three of all hospitalized patients in the U. S. are treated with or have a diagnostic test that utilizes some form of nuclear medicine. Nuclear medicine studies provide a "snapshot" of the metabolic activity at the time of the image, as opposed to other imaging procedures, such as radiography, which reveal only anatomic information.

Nuclear medicine techniques are especially versatile for basic research in the chemical, biological and physical sciences. Since techniques are similar, data in these areas are easily expanded into clinical research, allowing rapid application of information from the research laboratory to hospital practice. DOE supported research is conducted in several areas: the development of radiolabeled tracers, the refinement of PET (Positron Emission Tomography) and SPECT (Single Photon Emission Computed Tomography), the enhancement of imaging instrumentation and clinical feasibility studies of innovative nuclear medicine procedures.

The following are a few of many such applications, demonstrating the importance of a continuing high level of research:

CARDIAC NUCLEAR IMAGING

One of the most dramatic examples of the rapid transfer of research developments to the hospital is the non-invasive study of the heart. According to American Heart Association statistics, as many as 1,500,000 Americans will have a heart attack this year and more than 500,000 will die as a result. The number of deaths from heart and blood pressure diseases far exceeds the number of deaths from all cancers. In addition, the cost of cardiovascular disease in 1991 is estimated by the American Hospital Association at \$101.3 billion. This figure includes the cost of physician and nursing services, hospital and nursing home services, the cost of medications and lost productivity resulting from disability. Early identification of persons at risk of heart attack had previously been difficult. Nuclear diagnostic techniques are significantly more sensitive and less risky in identifying individuals with coronary artery disease than other diagnostic methods such as electrocardiographic stress testing. Studies from a number of PET centers note a very high sensitivity and specificity for PET in the diagnosis and evaluation of the severity of coronary artery disease.

PET is also accurate in determining myocardial viability. In patients with previous infarction, the determination of myocardial viability is important prior to revascularization. No other methods have been as accurate as PET in defining myocardial viability. It is estimated that 10-15% of patients undergoing revascularization may not benefit from the procedure. The economic impact of a method such as PET for identifying these patients is apparent.

DOE-sponsored research is also directed at the development and refinement of SPECT, similar in technology to PET, but one which is less expensive and can be readily available in most nuclear medicine departments. The importance and cost-effectiveness in the use of SPECT imaging is demonstrated by the patient who presents with chest pain and signs of a myocardial infarction, requiring hospitalization in the coronary care unit (CCU). The use of technetium-99m labeled isonitrite (which can be chelated within the laboratory of the nuclear medicine department and is available for emergency care) with SPECT imaging is a valuable tool in the triage of the cardiac patient and determining the short and long term care of the patient.

SPECT imaging is also used predominantly in screening for myocardial perfusion with radiothallium. This procedure constitutes 25-30% of the nuclear medicine laboratory activities. Treadmill exercise is generally used to produce stress. However, pharmacologic intervention (the use of the drugs Persantine or Adenosine) is being used to produce simulated cardiac stress. Parenteral Persantine was recently approved by the Food and Drug Administration (FDA); its availability will allow studies to be performed on patients who are currently considered poor candidates for the treadmill.

CANCER PATIENT EVALUATION

The major emphasis of nuclear medicine in oncology has shifted from the therapeutic application of radioisotopes to the use of enhanced imaging modalities which allow earlier detection and improved staging of cancers. In addition, there is growing use of nuclear medicine in monitoring the therapy of cancer and early discovery of recurrent or metastasized cancers. This information allows the clinician to continue or modify treatment. Among the more serious problems in cancer chemotherapy are the side effects produced by anti-cancer agents. Such effects can often be more efficiently monitored through the use of nuclear medicine procedures. For example, certain chemotherapeutic agents can adversely affect cardiac tissue. Nuclear medicine methods provide a guide to therapy whereby the level of drug toxicity and the possible drug induced heart failure can be avoided.

Despite this progress, present technology cannot successfully identify very small growths and often cannot determine their nature. Therefore, these techniques need to be improved by development of more specific radioactive drugs, by exploration of more sophisticated immunologic and biochemical methodology and by development of instruments with enhanced spatial resolution (such as that offered by PET and SPECT).

Research with radiolabeled monoclonal antibodies is an example of a promising new approach that is being pursued. Labeled monoclonal antibodies utilize the specificity of an antibody to a tumor as a way of localizing the dose. With the advent of monoclonal antibody technology particular attention has been given to the therapeutic isotopes. Several radioisotopes have been identified for potential use in this area of nuclear medicine. As radiolabeled monoclonal antibodies for melanoma, colorectal cancer, prostate cancer and lung cancer become clinically available, they will be important in use as a therapeutic modality for inflammatory arthritis and skeletal cancer metastases. Therefore, as the level of investigation of the monoclonal antibody technology and radioisotope use escalates, the production of and access to these radioisotopes will have to be addressed.

NEUROLOGIC APPLICATION

The National Advisory Neurologic and Communicative Disorders and Stroke Council have deemed the 1990's as the Decade of the Brain.

A significant contribution of the DOE - sponsored research is the investigation of the chemistry and metabolic patterns of the brain and central nervous system. PET is the first imaging technique that illustrates the metabolic activity in the various regions of the brain.

PET studies have clearly provided important information in the clinical management of patients with seizure disorders who are refractory to anticonvulsant therapy. Invasive techniques such as the placement of subdural strip electrodes and stereotactically - placed depth electrodes are typically used to evaluate these patients. These invasive techniques are costly and involve risk. The benefit of PET is that it allows the evaluation of the patient without the need for invasive monitoring. The findings on the PET scan demonstrate good correlation with the pathologic findings.

PET scanning is also useful in several aspects of the management of patients with primary brain tumors. PET scans are the only studies able to distinguish recurrent tumor from necrosis as a result of radiation therapy. PET scans are also useful in the initial staging of the tumor and guiding appropriate therapy.

DOE-sponsored investigators are also using PET scans in the study of dementias, stroke, epilepsy and neuropsychiatric disorders. With its advanced specificity, PET improves the clinician's ability to differentiate in his diagnosis between Alzheimer's, multiple infarct dementia, Huntington's and Parkinson's, to separate these diseases from the normal aging process and to remove confounding issues of therapies applied to patients that are heterogenous mixtures of different diseases. In addition, PET imaging is not only able to determine abnormal blood flow patterns in the brains of Alzheimer's patients, but is also capable of detecting this debilitating disease in its earlier mild and moderate stages.

In addition, for neuro-SPECT imaging, lipophilic gamma-emitting agents have been developed which diffuse readily into the brain after intravenous injection. These lipophilic complexes reflect regional differences in cerebral blood flow. Therefore, cerebrovascular disease can accurately be diagnosed, as can other diseases that demonstrate alterations in regional cerebral blood flow, such as head trauma, dementias and seizure disorders, with the use of SPECT.

Other than brain tumor extent and viability, SPECT, qualitatively, is equal to PET. Both techniques have clinically comparable resolution. The most notable difference is the more accurate quantification available with the tomographic images in PET. The improvement of SPECT instrumentation and quantification would significantly increase SPECT's utility. This is a significant research opportunity which at present is underfunded.

NUCLEAR MEDICINE INSTRUMENTATION

Progress in nuclear medicine research and the eventual application of research results in the clinical setting is dependent upon the refinement of existing instrumentation, the development of new technology and the availability of radioisotopes. The potential application of PET technology in the diagnosis and treatment of disease requires further refinements in its ability to resolve small structures more discreetly. In addition, since PET studies require costly, on-site cyclotrons, additional research and development is needed to design smaller less costly models so that more patients can benefit from this exciting technology. Further development of radionuclide positron emitters with half-lives of at least a few hours would relieve the dependency on immediate cyclotron production for certain applications.

Two recently approved cardiac imaging agents will increase the demand for dedicated SPECT scanners. DOE research funds could also be wisely invested in advancing the development of SPECT, which could be more readily available to nuclear medicine departments than PET.

PEER REVIEW OF PROJECTS

In order to continue the progress achieved in the field of nuclear medicine it is imperative that funding for research efforts be increased and should not be appropriated without scientific peer review. Earmarking funds for particular projects not only undermines the scientific peer review process but also is contrary to recommendations made by committees of distinguished experts whose counsel and evaluation was sought by the DOE.

As a result of flat annual funding increases that have not kept pace with inflation, disruptive earmarks of scarce nuclear medicine funds and internal programmatic reallocations within the Biological and Environmental Research Program, there has been insufficient funding to support the base nuclear medicine research program. In addition, appropriations for long-standing nuclear medicine research have been used for other projects by the DOE, due to inadequate funding of congressionally directed programs. The Society and College strongly urge Congress to reaffirm commitment to the traditional peer review process. A substantial and steady infusion of federal funds is needed to restore growth and promise in the DOE national nuclear medicine research program.

CONCLUSION

The Society and College urge Congress, as well as the Department of Energy, to continue to expand its support of nuclear medicine research activities. The Administration's budget request is inadequate to sustain projected future yields.

For the past several years, the nuclear medicine community has urged increases in the DOE Medical Applications program. A substantial and steady infusion of funds is necessary to counter the previous stagnant funding levels and to facilitate promising research which is based on competitive scientific review. Our recommendation for a \$5.3 million increase over 1991 funding for the program in FY 1992 will ensure support of vital research activities in nuclear medicine.

We want to assure the Committee that the nuclear medicine community will continue to work closely with the Department of Energy in the development of its research programs and the identification of opportunities in diagnostic imaging and therapy. The exchange of views and knowledge between DOE officials and the medical community helps to assure that the greatest possible benefit is derived from the funds committed.